U. S. DEPARTMENT OF INTERIOR
OIL SHALE
ENVIRONMENTAL ADVISORY PANEL
Denver Federal Center

PROPOSED RANGELY ACCESS ROAD TO TRACT C-a

OFFICE COPY
DO NOT REMOVE

For
Rio Blanco Oil Shale Project

By
International Engineering Co., Inc.
Division of
Morrison-Knudsen Co., Inc.

August 11, 1975

TN
859
.C64
R5636
1975

INTERNATIONAL ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS

1777 S. BELLAIRE ST. • DENVER, COLORADO 80222
PLANNING ENGINEERING ARCHITECTURE

88064983

BLM Library
D-553A, Building 50
Denver Federal Center
P. O. Box 25047
Denver, CO 80225-0047

TN
859
.C64
R5636
1975

PROPOSED RANGELY ACCESS ROAD
TO TRACT C-a

For

Rio Blanco Oil Shale Project

By

International Engineering Co., Inc.
Division of
Morrison-Knudsen Co., Inc.

August 11, 1975.

TABLE OF CONTENTS

	Page
Background	i
Major Findings	iii
Comparative Matrix	iv
Conclusions and Recommendations	v
Introduction	1
Previous Study	2
Traffic Estimates and Trip Distribution	4
Design Criteria	7
Basic Data Utilized	13
Route Analysis	17
A - Proposed Route - Gillam Draw-Spring Creek Route 9	17
B - Proposed Route - Big Ridge Route 3	30
C - Calamity Ridge Route 8	38
Benefit Cost Ratios	53
Accidents and Fuel Consumption	57
Timing	59
References	61

LIST OF TABLES

	Page
Table 1 - Trip Distribution	6
Table 2 - Estimated Design Hourly Volumes to Rangely	7
Table 3 - Geometric Design Standards for Highway Construction	9, 10
Table 4 - Geometric Design Standards - Type C	11
Table 5 - Relation of Speed to Curve Radius	12
Table 6 - Per Mile Construction Cost by Type of Terrain	13
Table 7 - Road User Costs: One-Way Vehicular Trips	54
Table 8 - Road User Cost Route Comparisons	55
Table 9 - Benefit Cost Ratios	56
Table 10 - Accident and Fuel Estimates	58

Background

Rio Blanco Oil Shale Project has proposed a route between Rangely and lease Tract C-a via Gillam Draw and Spring Creek. The proposed Gillam Draw-Spring Creek Route 9 is the most desirable access to Rangely.

Previously studied in a report titled "Preliminary Feasibility Route Selection C-a to Rangely" were a total of ten alternative routes. The report concluded that a Route 9 utilizing Gillam Draw and Spring Creek best served traffic between Tract C-a and Rangely. As a result, Rio Blanco Oil Shale Project endorsed the Gillam Draw-Spring Creek route and had copies of the report distributed to interested Federal, State, and County officials.

Late in June, the Gillam Draw-Spring Creek route was walked together with a field review of the Calamity Ridge Route 8. Early in July a field trip and review of the study was held in Rangely. Approximately 25 persons attended the review, including representatives of the Oil Shale Supervisors Office, the BLM Craig and Meeker offices, the Colorado Department of Highways District Engineer, Rio Blanco County officials, and a Rangely City councilman.

As a result of the July meeting, Rio Blanco Oil Shale Project requested additional study of Rangely access. Of the ten routes studied in the original route selection study, all but three routes were eliminated for further study. Of the seven eliminated, three (Yellow Creek Route 6, Yellow Creek Alternative Route 7, and Hay Canyon Route 5) were discarded because of their poor service to Rangely with consequent poor time, distance, and cost factors. Three routes (Rocky Point Draw Route 1, Fourmile Draw Route 2, and Philadelphia Draw Route 10) were eliminated

because of their location in an area designated by the BLM as a roadless preserve. The Spring Creek Route 4 was dropped because of construction difficulty and less service value as compared to the combined Gillam Draw-Spring Creek Route 9.

Thus, the evaluation made in the current analysis is limited to three routes. On an economic scale, these were rated in the previous study 2nd, 5th, and 7th for Gillam Draw-Spring Creek, Big Ridge, and Calamity Ridge, respectively. It should be recognized that in the previous study as well as the current, both Gillam Draw-Spring Creek and Big Ridge were designed specifically to give good access to Tract C-a. Thus, route distance and design standards are higher than those of Calamity Ridge Route 8. Calamity Ridge route has been designed to meet minimum design standards. This resulted in extensive sections of 30 MPH operation and consequent time penalty. To design Calamity Ridge to a higher standard would have resulted in reconstruction on new grade and alignment of approximately 7 miles of roadway. To do this would have defeated the intent of utilizing an existing road.

In summary, the Gillam Draw-Spring Creek Route 9 previously recommended was designed to serve a traffic demand. The proposed route does serve this need.

Major Findings

- The estimated traffic volumes from Tract C-a on a Rangely access road warrant a Type C geometric standard according to Colorado Department of Highway design standards.
- A Gillam Draw-Spring Creek Route No. 9 can be designed to meet the Colorado Department of Highways design criteria and provide a fast, safe travelway with favorable grades and horizontal curvature. The route saves approximately 20 minutes travel time for a decrease in worker commute time of 40 minutes daily over travel on an essentially reconstructed Calamity Ridge Route 8.
- Extensive and costly section widening, grade and curvature improvement is necessary on Calamity Ridge Route 8 to meet the minimum Colorado Department of Highways design criteria. It would not be feasible to construct Route 8 to higher standard (45 MPH minimum speed) of Route 9.
- A Big Ridge Route No. 3 is longer and slower than Route No. 9 and would have more negative aesthetic impact than the other routes. Design criteria will be extremely difficult to achieve at the crossing of Cathedral Bluffs. Cut and fill scars will be extensive at the summit. Route 3 has an undulating grade line typical of ridge locations. An extra 600 foot vertical climb is also necessary as opposed to Route 9.
- Gillam Draw-Spring Creek Route No. 9 makes joint use of the corridor for the roadway and a power line through a portion of the route.
- Route No. 9 has the greatest benefit cost ratio and highest road user benefits.

For ease of comparison of the three routes, the results of the study are summarized in the following comparative matrix.

COMPARATIVE MATRIX

	Route 3	Route 8	Route 9
Total Length - miles	27.4	34.9	24.8
Length New Construction - miles	24.4	24.9	21.8
Min. Horizontal Curve Radius - ft.	600	250	600
Max. Grade - %	8.5	8.2	8.0
Average Running Speed - mph	48	43	50
Min. Speed - MPH	45	30	45
Travel Time One Way - min.	34	49	30
Total Annual Vehicle Miles (1000)	9,379	11,777	8,485
Annual Fuel Consumption (1000 gal.)	625	785	566
Injury and Fatal Accidents	7.95	9.98	7.19
Construction Cost ($1000)	11,334	10,394	10,211
Annual Maintenance Cost ($1000)	31.6	32.9	29.3
Cost/Benefit Ratio	.75	.41	.97

Conclusions and Recommendations

From the material analyzed in this study, it is our conclusion that the conditions, conclusions and recommendations of the study "Preliminary Feasibility Route Selection C-a to Rangely" have not changed. After this more detailed review, all evidence reinforces the selection of a Gillam Draw-Spring Creek joint use corridor for produce pipe line, power line, and main access roadway between Tract C-a and Rangely.

Engineering should begin immediately together with necessary coordination to secure legislative funding. Time is of the essence to meet the construction schedules proposed.

Introduction

In early 1974 Rio Blanco Oil Shale Project, a joint venture of Standard Oil Company (Indiana) and Gulf Oil Company became lessee of Federal Oil Shale Tract C-a, Rio Blanco County, Colorado. In Oil Shale Lease Environmental Stipulations, Section 2, Access and Service Plans, paragraph (A) Transportation Corridor Plans it is stated that: "The Lessee shall provide corridor plans for roads, pipelines, and utilities on the Leased Lands for approval by The Mining Supervisor"... and "The Lessee shall, to the maximum extent practicable, make use of multi-use corridors for roads, pipelines and utilities." Paragraph (C) Existing and Planned Roads and Trails which states, "Where feasible, the Lessee shall use existing roads and trails." is also germane to planning transportation access to Tract C-a.

Road access to Tract C-a has heretofore been from the east only by way of Piceance Creek Road (Rio Blanco County Road No. 5) and Ryan Gulch Road (Rio Blanco County Road No. 24). Piceance Creek Road is all-weather asphalt paved road between State Highway 64 and State Highway 13 at the Rio Blanco store. Ryan Gulch Road is a natural surfaced road with some sections of single lane. Access to the east must be improved, however the general corridor of the existing county road appears direct and usable.

Although the country around Tract C-a is traversed by many 4-wheel drive trails, there is no direct access to the west. The nearest significant road in the area north and west of the tract is the Calamity Ridge Road. This road, constructed

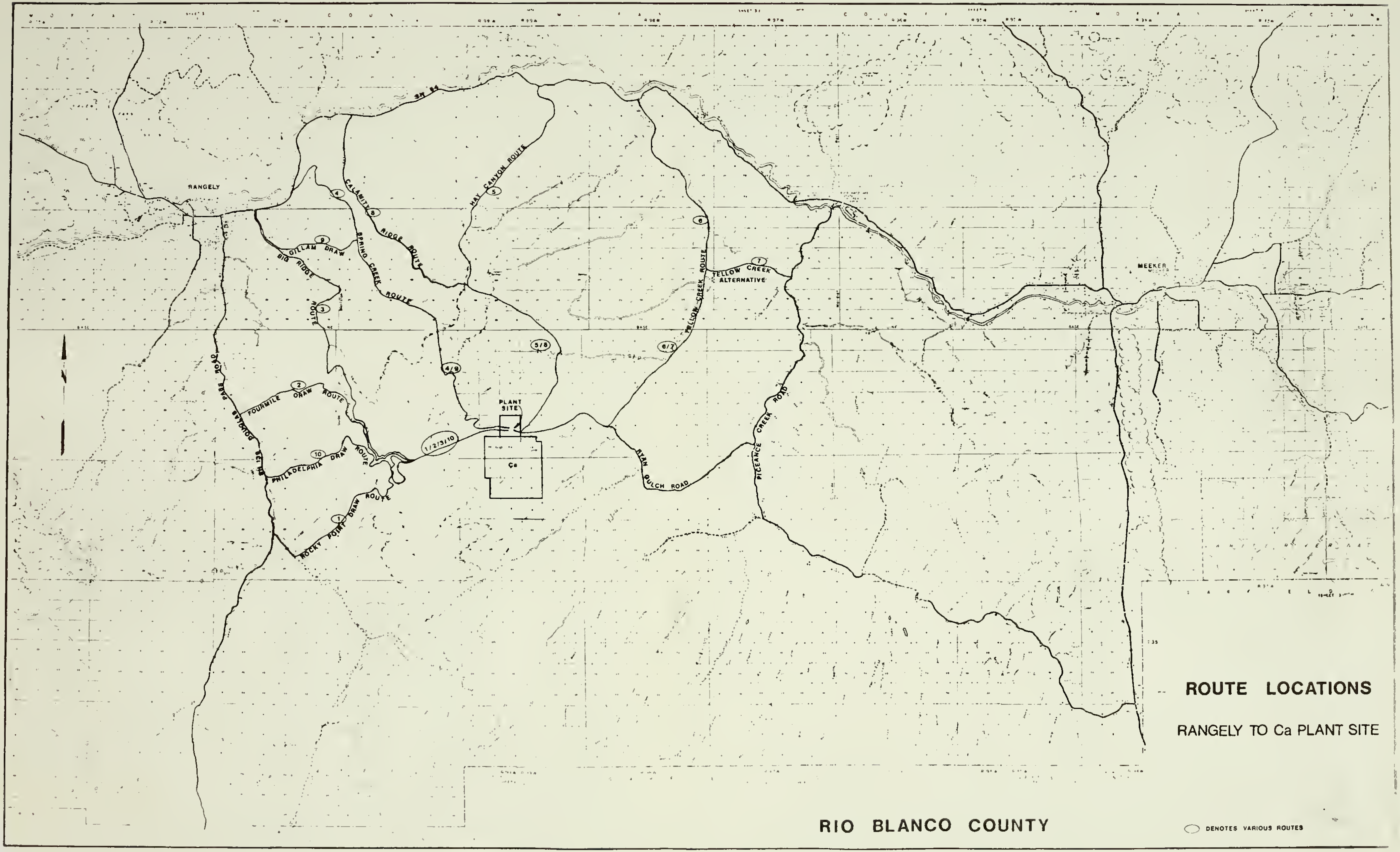
by BLM was apparently to give public and principally hunter access to the ridge areas. The route, as constructed, follows an east-west direction approximately 6 airline miles north of the tract and a north-south direction 10 miles east of Rangely. The following pages will discuss the Calamity Ridge Road in greater detail.

Previous Study

A study entitled "Preliminary Feasibility Route Selection C-a to Rangely" prepared for Rio Blanco Oil Shale Project by International Engineering Co. Inc., Division of Morrison-Knudsen Co. Inc., Revised March 4, 1975, was prepared. Impetus for this study as stated in it was:

> "Great concern has been expressed that a travel time of about one hour, thirty minutes, or a total of 3 hours per day commute time for workers at the C-a tract is intolerable. The 'Rapp Report' in fact dismisses Rangely as a community that would serve C-a. However, Rangely is only about 19 airline miles from C-a. A preliminary appraisal of the potential communities and their services indicates that good access to Rangely would have great merit..."

Ten alternative routes were studied including Big Ridge Route No. 3, Calamity Ridge Access Route No. 8, and Gillam Draw - Spring Creek Route No. 9.



ROUTE LOCATIONS

RANGELY TO Ca PLANT SITE

RIO BLANCO COUNTY

⬭ DENOTES VARIOUS ROUTES

The Rangely access study concluded that a route between C-a and Rangely was justified and that the Gillam Draw - Spring Creek Route No. 9 resulted in the greatest annual road user benefits and a consequent best benefit to cost ratio.

It is the purpose of the present study to more fully evaluate the relative merits of the three routes Big Ridge, Calamity Ridge and Gillam Draw - Spring Creek.

Traffic Estimates and Trip Distribution

The U.S. Department of Commerce, Bureau of Public Roads publication "Calibrating & Testing a Gravity Model for Any Size Urban Area" dated October 1965, states:

> "Trip distribution is an important and complex phase of the transportation planning process. It provides the planner with a systematic procedure capable of estimating zonal trip interchanges for alternate plans of both land use and transportation facilities. These zonal interchanges constitute a basic part of the travel information necessary for transportation planning."

... and

> "The use of trip distribution models in transportation planning offers certain advantages over other trip distribution forecasting techniques. Earlier it was suggested that a basic aim of the

> transportation planning process was to provide decision makers with quantitative information about the consequences of their decisions concerning the type, location, size, and timing of transportation improvements. Mathematical trip distribution models provide a common base for simulating the travel patterns expected to result from a variety of different highway or mass transit systems. This allows public officials to estimate and judge, in advance, the probable consequences in terms of travel patterns of a variety of different transportation systems."

The publication further states that:

> "To date, the most widely used trip distribution model has been the so-called 'gravity model.' As the name implies, this model adapts the gravitational concept, as advanced by Newton in 1686, to the problem of distributing traffic throughout an urban area (5). The gravity model has been the most widely used formula mainly because it is simple in concept and because it has been well documented."

The importance of traffic estimates is two fold. In route selection, estimates of the number of vehicles using a particular roadway network are the basis of assigning road user costs. After route selection has been made, traffic estimates are essential to select the proper design criteria. The criteria are a function of vehicular usage.

Estimates of work force were furnished by Rio Blanco Oil Shale Project. These estimates and the conversion to vehicular trips are fully explained in the March 4 study report, pages 5 and 6. In summary, they include:

Total Work Force	1000 Employees
Average Daily Work Force	630 Workers
Average Vehicle Occupancy	1.8 Persons per Vehicle
Average Daily Traffic (ADT)	800* Vehicles per Day

* Includes 100 trips for services, sales, etc.

A distribution of the estimated 800 ADT of Tract C-a between Meeker and Rangely was recomputed based upon most current study alignments. The gravity model using an exponent for time of two as in Reference 1 was used. The following distribution in trips resulted:

TABLE 1

TRIP DISTRIBUTION

	Trips C-a to	
Route	Meeker	Rangely
Big Ridge Route 3	160	640
Calamity Ridge Route 8	270	530
Gillam Draw-Spring Creek Route 9	130	670

The distribution in Table 1 was based on the existing population of Meeker and Rangely as the attraction factor in the gravity model formula. Plans are underway for a planned development in Rangely giving that town the services and facilities of a much larger city. On this basis, the figures in Table 1 are conservative in estimating the traffic assigned to Rangely.

In order to establish design criteria, an estimate of a design hourly volume (DHV) is needed. From the above table, the worker trips shown should repeat daily at nearly the same time and therefore are a good estimating basis for DHV. Plant operation is expected to be divided into three shifts, thereby reducing the peak hour traffic. It is assumed that approximately 40% of workers will report to the day shift with the remaining 60% divided equally into the night shifts. The 100 service trips must be deducted, as it is not expected that these would coincide with a shift change. Therefore, the following table of design hourly volumes results:

TABLE 2

ESTIMATED DESIGN HOURLY VOLUMES TO RANGELY

	Peak Hour Traffic		
Route	DHV Inbound	DHV Outbound	DHV Total
Big Ridge Route 3	112	84	196
Calamity Ridge Route 8	93	70	163
Gillam Draw-Spring Creek Route 9	117	88	205

Therefore, at shift change time for the day shift a roadway would experience between 163 vehicles and 205 vehicles in a one-hour period.

Design Criteria

The proposed access could fall under any of three governmental jurisdictions including the U. S. Department of Interior, Bureau of Land Management, the State of Colorado Department of Highways, or Rio Blanco County. Each of these governmental units has an operating road function. Of the three, however, only the State of Colorado Department of Highways has a published criteria that deals routinely with traffic volumes approaching the magnitude anticipated on a Rangely to Tract C-a

access. Because of this, and because the standards of the Colorado Department of Highways (CDOH) are an accepted statewide standard for the safe and efficient construction and operation of roadways, to accept a lesser standard would be derelict. Moreover, in all probability, based on action of the 1975 Colorado State Legislature, the CDOH will be responsible for implementing a selected Rangely to Tract C-a access construction program. In that event, CDOH would use its design standards, the introduction of which defines their application thus:

> "Minimum Standards
>
> "The following standards generally represent minimum values. The word ' minimum' implies the lowest acceptable limit in design.
>
> "Departures from the Standards
>
> "Design policies and standards are not inflexible. Higher standards may be used within reasonable economic limits. To insure uniform practice on a statewide basis, lower design standards may not be used without approval from the Office of the Chief Engineer."
>
> "Policy on Use of AASHO Standards
>
> "The American Association of State Highway Officials has published policies on Geometric Design of Rural and Urban Highways.
>
> "The Colorado Division of Highways generally follows these policies. When standards used in this manual differ from the AASHO policies, this manual shall govern."

GEOMETRIC DESIGN STANDARDS FOR HIGHWAY CONSTRUCTION

AVERAGE TRAFFIC, DESIGN PERIOD △1	PAVEMENT TYPE △2	NO. OF LANES	LANE WIDTH	SHOULDER WIDTH, MIN.		DESIGN SPEED M.P.H.	DESIRABLE MAX GRADE %	R.O.W. WIDTH			DESIRABLE ACCESS CONTROL	MAXIMUM DEGREE OF CURVE	BRIDGES AND SEPARATIONS	
				OUT-SIDE	IN-SIDE			DESIRABLE	MINIMUM WITH FRONTAGE ROADS	MINIMUM WITHOUT FRONTAGE ROADS			DESIGN LOAD	CLEAR ROADWAY WIDTH △9
TYPE A-A 4,001-8,000 (DHV) 25,001-50,000 (ADT) Plains Rolling Mountainous	HIGH	6	12'	10' 10' 10'	8' 8' 8'	∅ 60-80 60-80 70	△4 See Table 202.3	300' 300' 300'	275' 275' 275'	175' 175' 175'	Full Full Full	See Table 201.2	△7 HS20-44 HS20-44 HS20-44	
TYPE A 705-4,000 (DHV) 4,401-25,000 (ADT) Plains Rolling Mountainous	HIGH OR HIGH MEDIUM	4	12'	10' 10' 10'	4' 4' 4'	∅ 60-80 60-80 70		300' 300' 300'	250' 250' 250'	150' 150' 150'	△6 Full Full Full		△7 HS20-44 HS20-44 HS20-44	
TYPE B 401-704 (DHV) 1,501-4,400 (ADT) Plains Rolling Mountainous	HIGH OR HIGH MEDIUM	△3 2	12'	8'	-	30-80		250'+ 250'+ 250'+	250' 250' 250'	150' 150' 150'	△6		△7 HS20-44	
TYPE C 201-400 (DHV) 751-1,500 (ADT) Plains Rolling Mountainous	HIGH MEDIUM	△3 2	11' 12'	8' 8'	- -	30-40 50-80		150' 150' 150'	-- -- --	△5 120' 120' 120'	△6		HS20-44 HS20-44 △7	
TYPE D 101-200 (DHV) 401-750 (ADT) Plains Rolling Mountainous	MEDIUM	△3 2	10' 11' 12'	6' 6' 6'	- - -	30 40-60 65-80		120' 120' 120'	-- -- --	△5 80' 80' 80'	△8		H20-44 H20-44 H20-44 △8	
TYPE E (DHV) < 100 251-400 (ADT) Plains Rolling Mountainous	LOW MEDIUM	2	10' 11' 12'	4' 4' 4'	- - -	30-50 60-70 75-80		100' 100' 100'	-- -- --	△5 60' 60' 60'	△6		H20-44 H20-44 H20-44 △8	
TYPE F 51-250 (ADT) Plains Rolling Mountainous	LOW	2	10' 12'	4' 4'	- -	30-70 75-80		100' 100' 100'	-- -- --	△5 60' 60' 60'	△6		H20-44 H20-44 △8	
TYPE G 0 - 50 (ADT) Plains Rolling Mountainous	GRAVEL	2	10'	3'	-	20-60		80' 80' 80'	-- -- --	△5 60' 60' 60'	△6		H20-44 △8	

△x *See FOOTNOTES on next sheet.*

∅ *Speeds of 75 or 80 mph are applicable only to highways with full control of access or where such control is planned for in the future.*

GEOMETRIC DESIGN STANDARDS FOR HIGHWAY CONSTRUCTION

FOOTNOTES

△1 *The "Types" indicated refer to details shown on Division Standard covering typical cross sections. All designs are now based on the 30th highest hour (Design Hourly Volume) (DHV). Unless actual traffic counts give a different value, the 30th highest hour is assumed to be 16% of the 24-hr. annual traffic volume.*

△2 *PAVEMENT TYPES:*

HIGH = Portland Cement Concrete or Bituminous Pavement (>5")
HIGH MEDIUM = Bituminous Pavement (5")
MEDIUM = Bituminous Pavement (3" to 5")
LOW MEDIUM = Bituminous Pavement (3")

When comparative estimates indicate that a higher surface type can be constructed for a cost approaching the cost of lower surface type, the higher type shall be used.

△3 *Climbing lanes to be provided in accordance with 202.5.*

△4 *In unusual cases, the maximum shown may be altered after approval by the Chief Engineer. Grades on Interstate shall be a maximum of 5% which may be increased to 7% in rugged terrain.*

△5 *In unusual cases, the minimum shown may be altered after approval by the Chief Engineer.*

△6 *To be decided on an individual project basis. Interstate requires full access.*

△7 *Alternate loadings for two 24,000-pound axles shall be used where applicable on Interstate.*

△8 *Where the character of traffic is predominantly passenger vehicles or other unusual conditions exist, this loading may be reduced on order of the Chief Engineer.*

△9 *Bridge widths will be determined in accordance with requirements set forth in the latest revision of AASHO Publications,* A Policy on Design Standards-Interstate, Geometric Design Standards for Highways Other than Freeways, Standard Specifications for Highway Bridges *and* Division "M" Standards. *Special cases will be subject to consideration by the Bridge Engineer.*

Table 101.2, revised November 1973, is reproduced herein as Table 3 for reference. The previous section on traffic estimates established a DHV of between 163 and 205. Referring to Table 3 for these DHV's indicates that a Type C standard is applicable for Big Ridge Route 3 and Gillam Draw-Spring Creek Route 9, while a Type D standard is sufficient for Calamity Ridge Route 9. However, design should be based on anticipated traffic volumes 20 years hence, therefore use of Type C for all three routes is more appropriate.

The following Table 4 summarizes the CDOH criteria for Type C highway geometrics:

TABLE 4

GEOMETRIC DESIGN STANDARDS
Type C

Pavement Type	High Medium
No. Lanes	2
Lane Width	11' - 12'
Shoulder Width	8'
Design Speed	30 - 80 mph
Max. Grade (1)	
Flat	4% - 6%
Rolling	5% - 7%
Mountainous	7% - 9%
Min. Radius (2)	
Flat	758'
Rolling	464'
Mountainous	250'

(1) Higher figure denotes design speed 30 mph.
(2) Assuming maximum superelevation of 0.08'/ft

Relating speed to radius of curvature used in design, the formula

$$R = \frac{0.067V^2}{e + f}$$

where:
e = Rate of roadway superelevation, foot per foot
f = Side friction factor for design
v = Speed in MPH

Assuming a value of e = 0.08'/' recommended maximum in higher elevations and values of f from CDOH Table 201.2 interpolated, the resulting radii are shown in Table 5 below:

TABLE 5

RELATION OF SPEED TO CURVE RADIUS

Speed	e + f	R
30	0.24	251
35	0.235	349
40	0.23	466
45	0.225	603
50	0.22	761
55	0.215	943

Basic Data Utilized

Maps for study alignments included USGS mapping at a scale of 1"=2000' (1:24000). Pertinent quadrangles included:

Cactus Reservoir Quadrangle 7.5 minute series 1962

Gillam Draw Quadrangle 7.5 minute series 1962

Calamity Ridge Quadrangle 7.5 minute series 1962

Philadelphia Creek Quadrangle 7.5 minute series 1964

Sagebrush Hill Quadrangle 7.5 minute series 1964

Additional mapping at a scale 1"=500' (1: 6000) were available for Sections 19, 20, 21, 28, 29, 30 and 31, Township 1 South, Range 99W. This mapping was accomplished by Rio Blanco Oil Shale Project in 1974.

Estimates of construction cost were developed in the Reference 1 study. These costs have been adjusted for a 40 foot section. To make this adjustment the per mile cost has been increased 4.46% based on a detailed breakdown that had shown surfacing constituted 22.3% of the per mile cost. Increasing width from 32 foot to 40 foot is a 20% increase, or the 4+% increase of total per mile costs. Table 6 summarizes the revised per mile costs by terrain type.

TABLE 6

PER MILE CONSTRUCTION COST
BY TYPE OF TERRAIN

Type of Terrain	Cost/Mile
Following Light Duty Road	$ 208,900
Following Unimproved Dirt Road	261,150
Mountain Construction	522,300
Mountain Bench Road Construction	1,044,600

In keeping with the previous section on design criteria, it was stated that a Type C section be used. On the following pages are "Standard Typical Sections" Standard M-400-C1 and M-400-C2 revised 11/6/73. These sheets describe the salient elements for the proposed roadway.

FEDERAL ROAD REGION NO	DIVISION	PROJ NO	SHEET NO	TOTAL SHEETS
VIII	COLORADO			

REVISIONS			
(R-1)	11-6-73	Slopes, Dim & Sl Tables, Seal Coat	M.R.H.

CROWNED SECTION

TYPE B Through F SECTION

STANDARD M-400-C1

(OCTOBER 22, 1971)

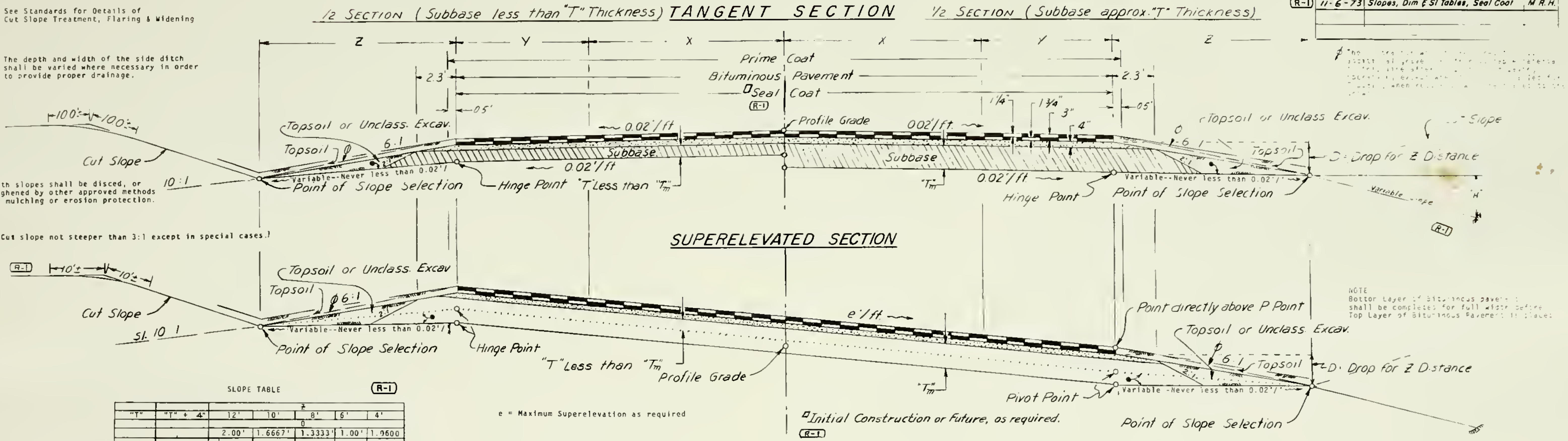
NOTE

See Standards for Details of Cut Slope Treatment, Flaring & Widening

The depth and width of the side ditch shall be varied where necessary in order to provide proper drainage.

Earth slopes shall be disced, or roughened by other approved methods for mulching or erosion protection.

Cut slope not steeper than 3:1 except in special cases.



NOTE
Bottom Layer of Bituminous Pavement shall be completed for full width before Top Layer of Bituminous Pavement is placed.

e = Maximum Superelevation as required

□Initial Construction or Future, as required.
(R-1)

SLOPE TABLE (R-1)

"T" = SUBBASE THICKNESS

"T"	"T" + 4"		Z 12'	10'	8'	6'	4'
		D					
			2.00'	1.6667'	1.3333'	1.00'	1.0600
4	8	●SLOPE	0.111	0.100	0.083	0.056	0.056
5	9		0.104	0.092	0.073	0.042	0.044
6	10		0.097	0.083	0.063	0.028	0.033
7	11		0.090	0.075	0.052	0.014	0.020
8	12		0.083	0.067	0.042	0.000	
9	13		0.076	0.058	0.031		
10	14		0.069	0.050	0.021		
11	15		0.063	0.042	0.010		
12	16		0.056	0.033	0.000		
13	17		0.049	0.025			
14	18		0.042	0.017			
15	19		0.035	0.008			
16	20		0.028	0.000			
17	21		0.021				
18	22		0.014				
19	23		0.007				

(R-1) ●*Slope of subgrade from shoulder to point of slope selection.*

DIMENSION TABLE

TYPE SECTION	DHV	ADT	DESIGN SPEED MPH	X FT.	Y FT.	X+Y FT.	Z FT.	** T_m FT.
B	401-704		30 - 80	12	8	20	12	1.43
C	201-400		30 - 40	11	8	19	12	1.43
			50 - 80	12	8	20	12	1.43
D	101-200	401-750	30	10	6	16	10	1.14
			40 - 60	11	6	17	10	1.14
			65 - 80	12	6	18	10	1.14
E	< 100	251-400	30 - 50	10	4	14	8	0.84
			60 - 70	11	4	15	8	0.84
			75 - 80	12	4	16	8	0.84
F		51-250	30 - 70	10	4	14	6	0.55
			75 - 80	12	4	16	6	0.55
G		0- 50	20 - 60	10	3	13	4	0.92

(R-1) (R-1)

** If the required subbase thickness "T" for a sectic exceeds "T_m", dimension "Z" must be increased to "ZZ" which is the distance where the required thickness of subbase "T" continued on 0.02'/ft. slope intersects the 6:1 slope from the shoulder.

(R-1)

"T_m" thickness is the mathematical thickness which allows the bottom subbase line dropping on a 0.02'/ft. slope, to intersect the 6:1 line from the shoulder point exactly "Z" distance from the shoulder point.

NOTES

All Sections shown are subject to modifications depending on requirements of each project.

All thicknesses of Base Course and Surface Course are to be shown on plans as approximate. Thickness other than minimum as shown for Bituminous Pavement is governed by stabilometer value of the Base Course.

Details of speed change lanes will be shown on plans.

(R-1)

Break points on slopes and in bottoms of ditches shall be rounded on construction for a pleasing appearance.

The plans will show the distance below subgrade and the locations on the project where construction of embankment and treatment of cut areas with moisture and density control is required.

(R-1)
FILL SLOPES ø

"H"	SLOPE
10' OR LESS	6:1
10'+ TO 25'	4:1
OVER 25'	3:1

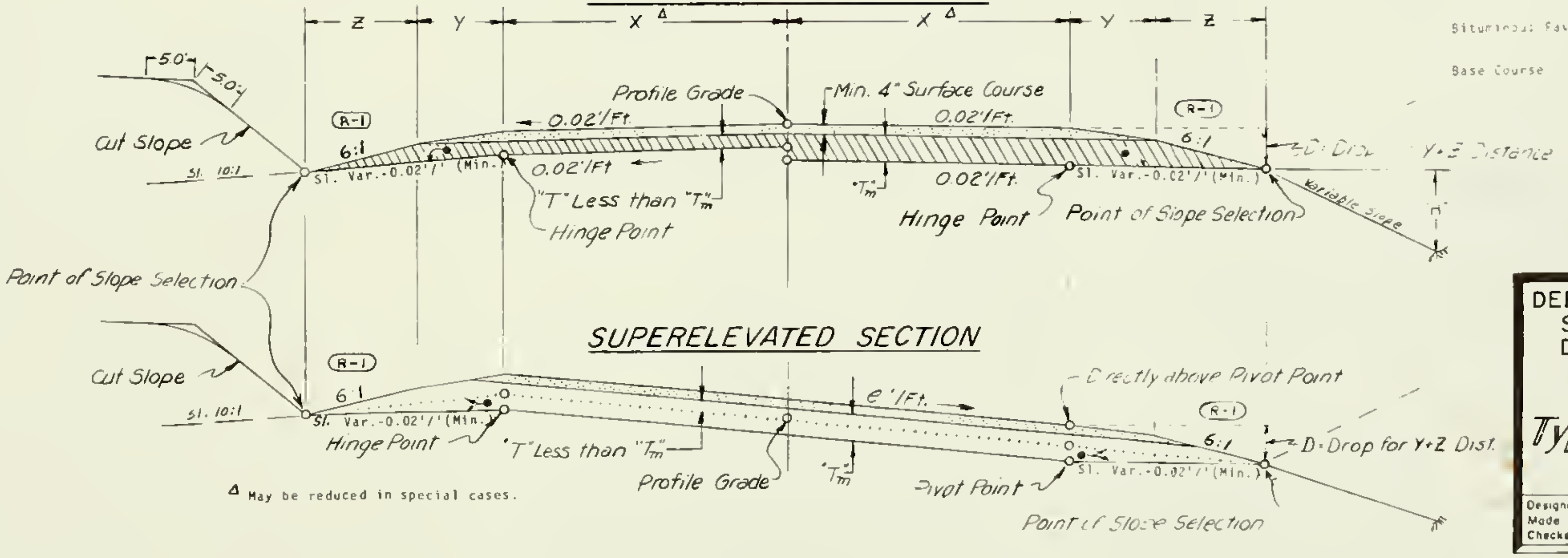
ø In special cases s pe may be steepened.

Material shall be placed in separate courses at the following rates per 100 linear feet of roadway

Bituminous Pavement Top Layer Tons
Bottom Layer Tons
Base Course Tons

TYPE G SECTION

TANGENT SECTION



Δ May be reduced in special cases.

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

Standard Typical Sections

Designed by J W K	Approved by Tom M. Cox
Made by	Staff Design Engineer
Checked by D L V	Date: October 22, 1971

FEDERAL ROAD REGION NO	DIVISION	PROJ NO	SHEET NO	TOTAL SHEETS
VIII	COLORADO			

CROWNED SECTION
TYPE B Through F SECTION

STANDARD M-400-C2
(OCTOBER 22, 1971)

REVISIONS		
(R-1) 11-6-73	Slopes, Dim. & Fill Slope Tables	W.R.H.

NOTE

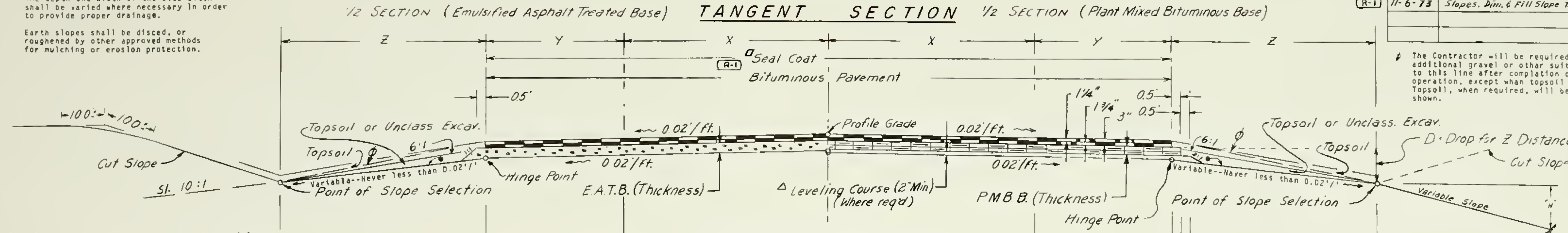
See Standards for Details of Cut Slope Treatment, Flaring & Widening

The depth and width of the side ditch shall be varied where necessary in order to provide proper drainage.

Earth slopes shall be disced, or roughened by other approved methods for mulching or erosion protection.

ø The Contractor will be required to place additional gravel or other suitable material to this line after completion of paving operation, except when topsoil is called for. Topsoil, when required, will be placed to the line shown.

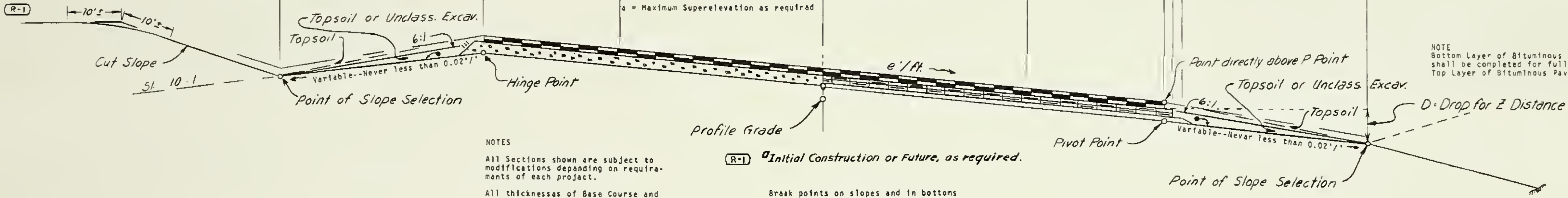
TANGENT SECTION



Cut slope not steeper than 3:1 except in special cases.

SUPERELEVATED SECTION

a = Maximum Superelevation as required



NOTE
Bottom Layer of Bituminous pavement shall be completed for full width before Top Layer of Bituminous Pavement is placed.

(R-1) ▫Initial Construction or Future, as required.

NOTES

All Sections shown are subject to modifications depending on requirements of each project.

All thicknesses of Base Course and Surface Course are to be shown on plans as approximate.

Details of speed change lanes will be shown on plans.

Break points on slopes and in bottoms of ditches shall be rounded during construction for a pleasing appearance.

The plans will show the distance below subgrade and the locations on the project where construction of embankment and treatment of cut areas with moisture and density control is required.

(R-1)

FILL SLOPES ø

"H"	SLOPE
10' OR LESS	6:1
10'+ TO 25'	4:1
OVER 25'	3:1

ø In special cases slope may be steepened.

SLOPE TABLE

THICKNESS		Z			
E.A.T.B. OR P.M.B.B.	P.M.B.B. + 2" B.C.	12'	10'	8'	6'
		D			
		2.00	1.66667	1.33333	1.00
		SLOPE •			
2		0.153	0.150	0.146	0.139
3		0.146	0.141	0.136	0.125
4	4	0.139	0.133	0.125	0.111
5	5	0.132	0.125	0.115	0.097
6	6	0.125	0.117	0.104	0.083
7	7	0.118	0.108	0.094	0.069
8	8	0.111	0.100	0.083	0.056
9	9	0.104	0.092	0.073	0.042
10	10	0.097	0.083	0.063	0.028
11	11	0.090	0.075	0.052	
12	12	0.083	0.067	0.042	
	13	0.076	0.058	0.031	
	14	0.069	0.050	0.021	

• Slope of subgrade from shoulder to point of slope selection.

NON SWELLING SOILS ON SUBGRADE

△ Where required a leveling course (2" min.) may be used to:

1. Enable fine grading on rough subgrade.
2. Act as a temporary wearing course where traffic must use the road before P. M. B. B. is applied.
3. Or as recommended by the district.

On non-swelling subgrades, the leveling course may be gravel or other non-swelling soils.

SWELLING SOILS ON SUBGRADE

△ Where required a leveling course may be used to enable fine grading on the swelling soil subgrade.

On swelling subgrades, gravel will not be permitted as a leveling course, and dense non-swelling soils shall be used in lieu of gravel to help prevent moisture from getting to the subgrade and also cut down on hydrogenesis.

Material shall be placed in separate courses at the following rates per 100 linear feet of roadway:

Bituminous Pavement	Top Layer	Tons
	Bottom Layer	Tons
Base Course		Tons
Treated Base		Tons

DIMENSION TABLE (R-1) (R-1)

TYPE SECTION	DHV	ADT	DESIGN SPEED MPH	X FT.	Y FT.	X+Y FT.	Z FT.
B	401-704		30 - 80	12	8	20	12
C	201-400		30 - 40	11	8	19	12
			50 - 80	12	8	20	12
D	101-200	401-750	30	10	6	16	10
			40 - 60	11	6	17	10
			65 - 80	12	6	18	10
E		251-400	30 - 50	10	4	14	8
			60 - 70	11	4	15	8
			75 - 80	12	4	16	8.
F		51-250	30 - 70	10	4	14	6
			75 - 80	12	4	16	6

(R-1)

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

Standard Typical Sections

Designed by JWK	Approved by
Made by	Staff Design Engineer
Checked by DLV	Date: October 22, 1971

Route Analysis

The following discussion summarizes the analysis of three routes from Rangely to Tract C-a; Gillam Draw-Spring Creek Route 9, Big Ridge Route 3, and Calamity Ridge Route 8.

A. Proposed Route - Gillam Draw-Spring Creek Route 9

1. Description

(a) Route Log - This route begins at Station 00 at an intersection with Colorado 64 on the east side of the Gillam Draw Bridge three miles east of Rangely. The line crosses the Flats for 3000 feet then proceeds up Gillam Draw on the east side of the main channel to Station 160. It then climbs out of the main canyon at a 5 - 7% grade on side hill cuts to Station 220 where a through cut of 20 - 30 feet will be required.

The route crosses the ridge at Station 295 at an elevation of 6370 then descends on the west side of Big Canyon on a 6 - 8% grade to Spring Creek. The last 1000 feet of the grade into Spring Creek will require a fill with a maximum height of 40 feet. The route enters the main canyon on a 900 foot radius curve and crosses to the east side of the creek approximately 2000 feet upstream of Big Canyon at Station 370.

Some minor alignment adjustment may be necessary in this section of Spring Creek to accommodate the proposed power line location. Final adjustment of both power transmission and roadway

will be made during the preliminary design phase when detailed mapping is available.

From this point to Station 500 the line hugs the toe of the north face of the canyon on gentle curvature and relatively flat grades (1.5 0 3.0%).

At Station 500 the line swings easterly up the east fork of Spring Canyon crossing private land from Station 512 to Station 638. At Station 700 the broad canyon constricts abruptly and the line begins climbing the talus slopes on the west face of the canyon on an 8% grade, crossing three side canyons with 20 - 40 foot fills. The line reaches the ridge at Station 797 and crosses at elevation 7730 which is the lowest saddle of the ridge.

The line then progresses to the upper reaches of Duck Creek where it crosses the canyon on a 65 foot fill. It continues, circling the ridges on 600 foot radius curves and moderate grades, past Cottonwood Springs (Station 960) to Big Duck Creek where a 400 - 500 foot bridge will be required to cross the canyon (approximately Station 994). The line continues climbing the northwest slope circling the east end of Dead Horse Ridge then descends a relatively gentle slope from Station 1100 to the proposed plant site at Station 1150.

A sub-alternate (9-A) was studied to ascertain the possibility of eliminating the 8% grade from Station 315 to Station 350 descending into Spring Creek and the high fill required at Station

350. On this sub-alternate, rather than following Big Canyon in a northeasterly direction, the line turns south and follows the ridge to Station 380 then descends into Big Canyon on a 6% grade. It crosses the creek at Station 408 then turns northeasterly, climbing to circle a point on the ridge between Big Canyon and Spring Creek. It then descends the northeast slope of Spring Creek canyon crossing the west fork of Spring Creek at Station 515 and the east fork at Station 522. It intersects Route 9 at Station 530 on Route 9-A (Station 504 on Route 9). Although this sub-alternate could be designed with grades not exceeding 6% and curves with 600 radii or greater, the line adds 2600 feet to the length of the road and is not recommended.

(b) Exposure - This route lies generally in a northwest-southeast direction and will have the advantage of the prevailing winds to minimize snow drifting during the winter.

For the most part, the road would be located on the south face of the hills and should be in the sun most of the day. There may be some portion of the road in the upper part of Spring Canyon which would be shaded during the late afternoon.

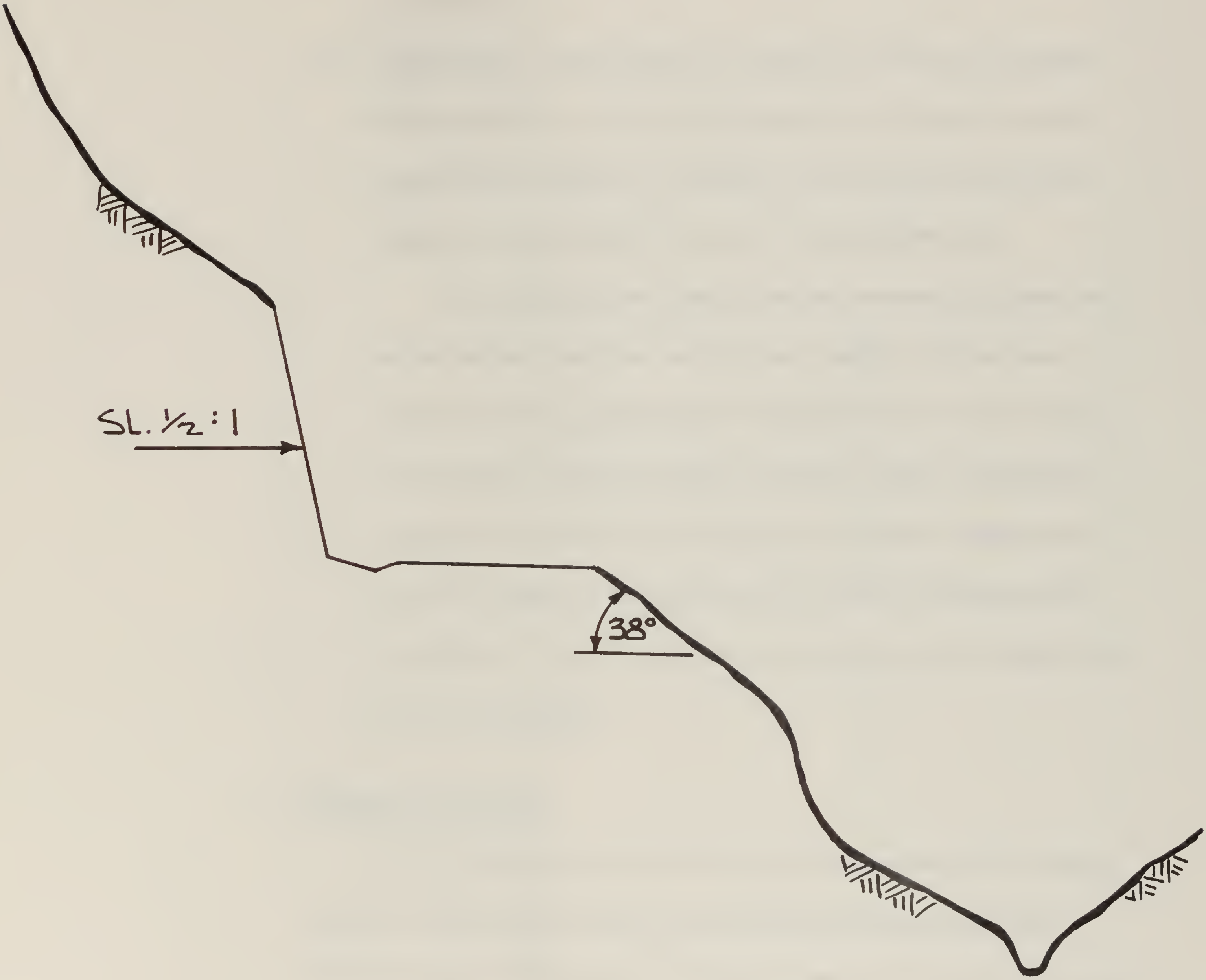
(c) Effect on State Highway System - Little effect on the existing state highway system is expected from the construction of this route. Although the traffic generated by travel to and from the plant site will increase the average daily traffic on the three miles from

Rangely to the Gillam Draw turnoff, the traffic is expected to be principally passenger-type vehicles which will have little effect on the pavement structure. Some additional signing would be required at the intersection of State Highway 64 and the access road.

(d) Effect on the Terrain - Adequate design precautions of channel bank protection and revegetation of disturbed areas are assumed. Guides on revegetation and erosion control will be incorporated into any road construction. Between Stations 70 and 110 in Gillam Draw, special care must be taken between possible conflict between road and channel. Gillam Draw does not carry a live stream and all evidence points to fairly small peak runoff. Some channel changes may be necessary as well as bank rip-rap protection in this highly erosive soil.

A similar problem exists in Spring Creek canyon between Big Canyon and the west fork of Spring Creek. This drainage area is larger and the stream live. The canyon is, however, wider and the roadway for the most part a greater distance away.

In the tight canyon section of upper Spring Creek a bench section with steep back slopes can be fit without extensive damage. A representative section of treatment in the canyon is shown on the following page. In any event, the route is quite isolated and



— REPRESENTATIVE SECTION —

SPRING CREEK CANYON

therefore any scarring caused by the new construction should be less offensive.

(e) Right-of-Way - Private lands are crossed in the first one-quarter mile immediately south of State Highway 64 at Gillam Draw and again between Stations 511 and 638 in the Spring Creek Canyon section. The remainder of the route traverses BLM land.

In the Spring Creek Canyon section between Big Canyon and Indian Springs Draw there may be some conflict with the route location and the proposed power transmission line to the C-a plant site presently under application with BLM by Moon Lake Electric Association. Officials of that company have been contacted and there do not seem to be insurmountable problems connected with the conflict. It may be necessary for some joint use of right-of-way for the two facilities.

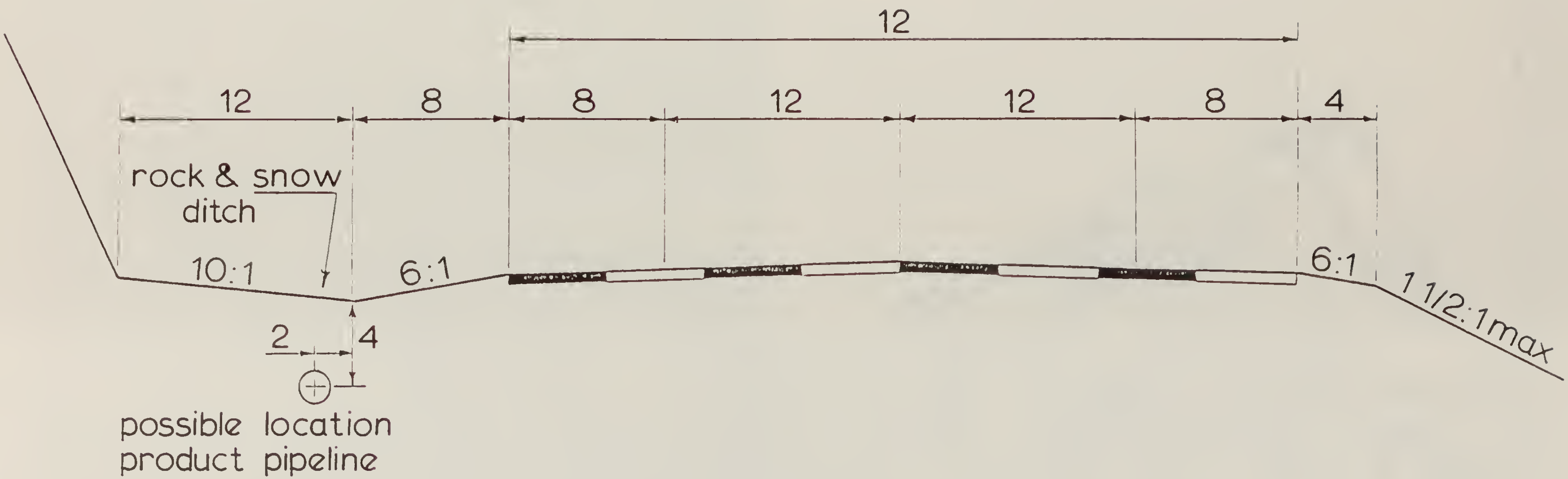
2. Alignment and Profile

The attached plan and profile sheets prepared from USGS mapping indicate the approximate location and expected grades on this route. Due to the scale of the mapping and contour interval, the lines are approximate only and refinements will be made when more precise mapping is available.

The grades anticipated for this route are

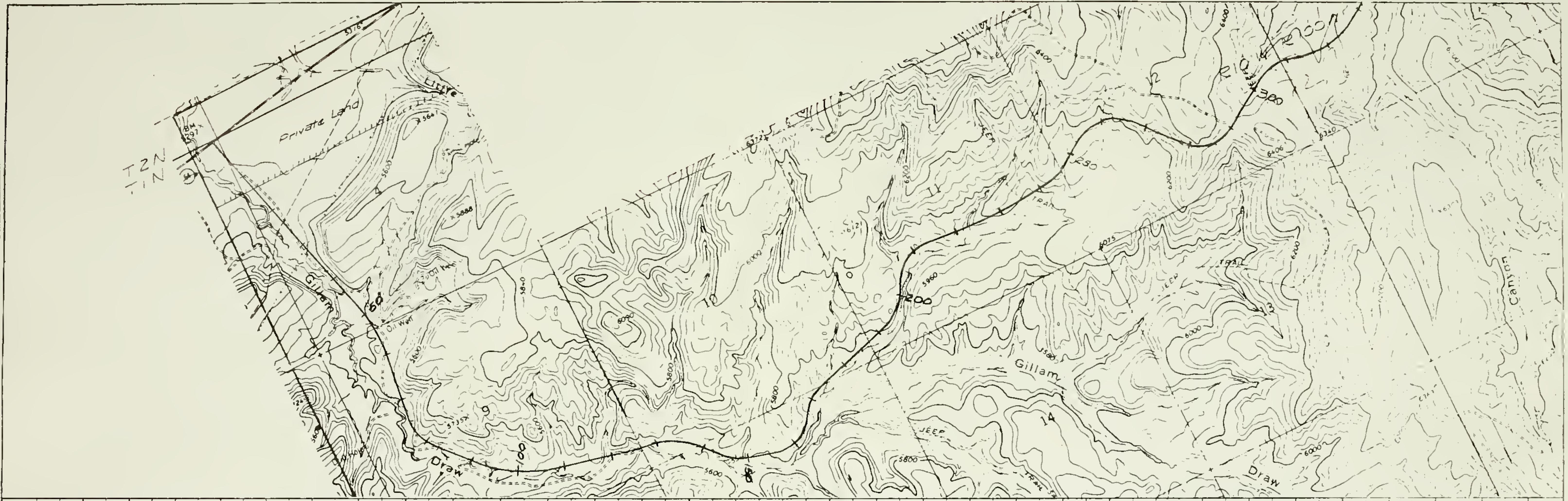
0 - 4%	8.7 miles
4 - 6%	8.6 miles
6 - 8%	4.4 miles

The minimum curve radius on the route would be 600 feet.



- TYPICAL SECTION -

SEE M-STANDARDS FOR DETAILS - PG. 15 & 16



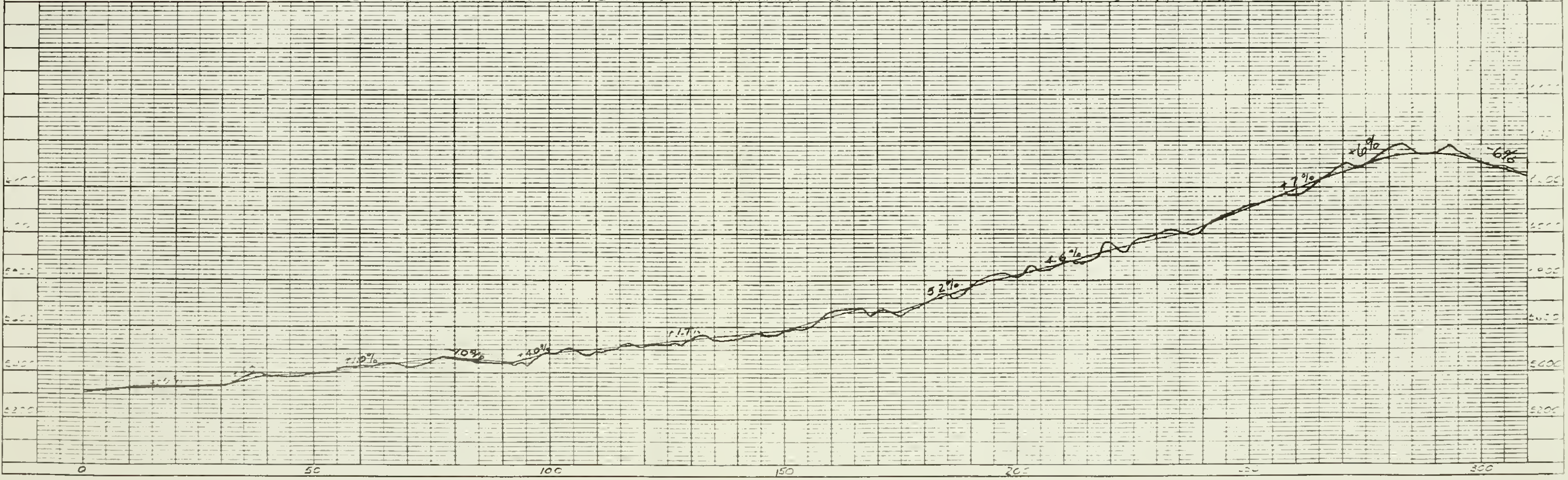
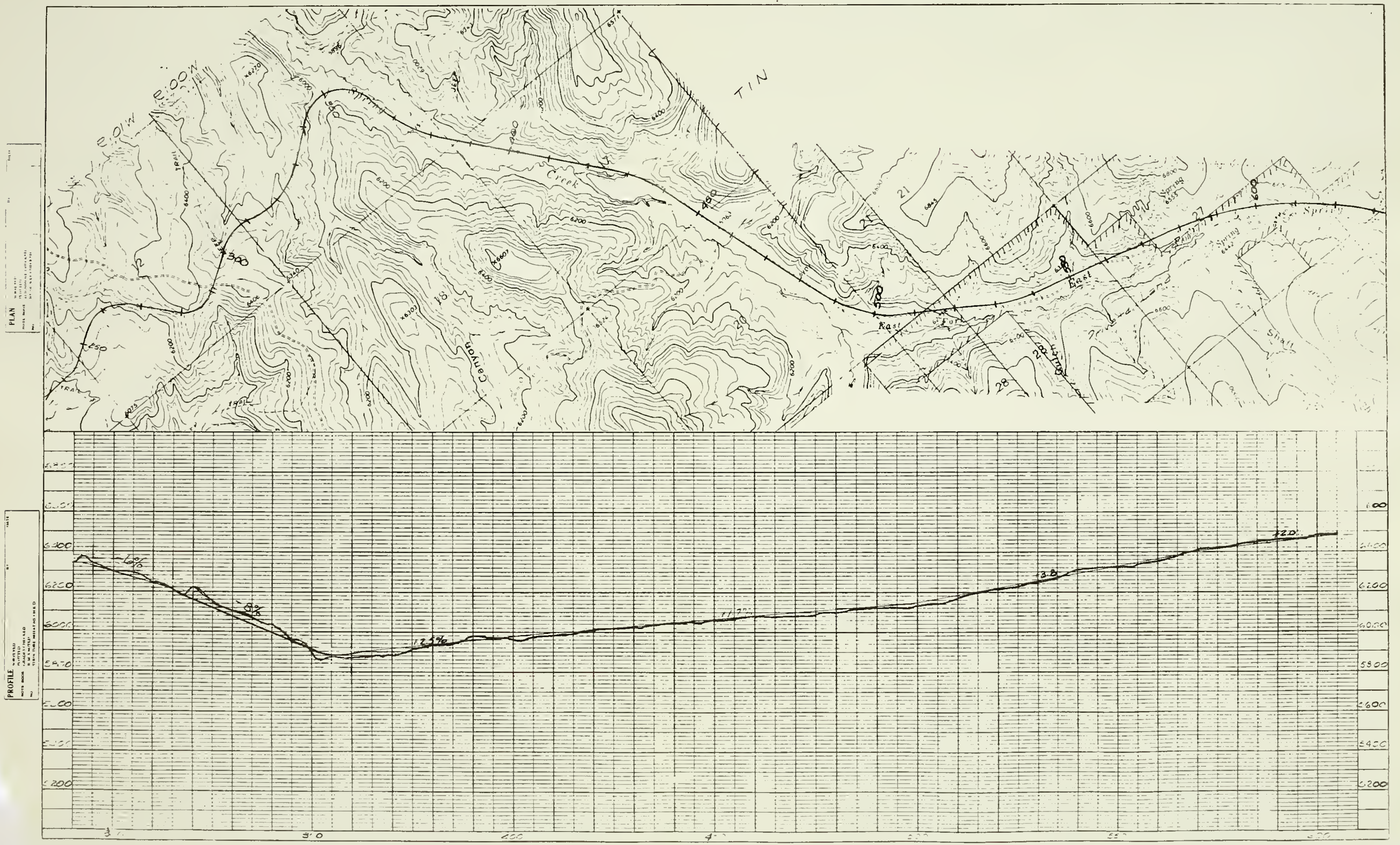
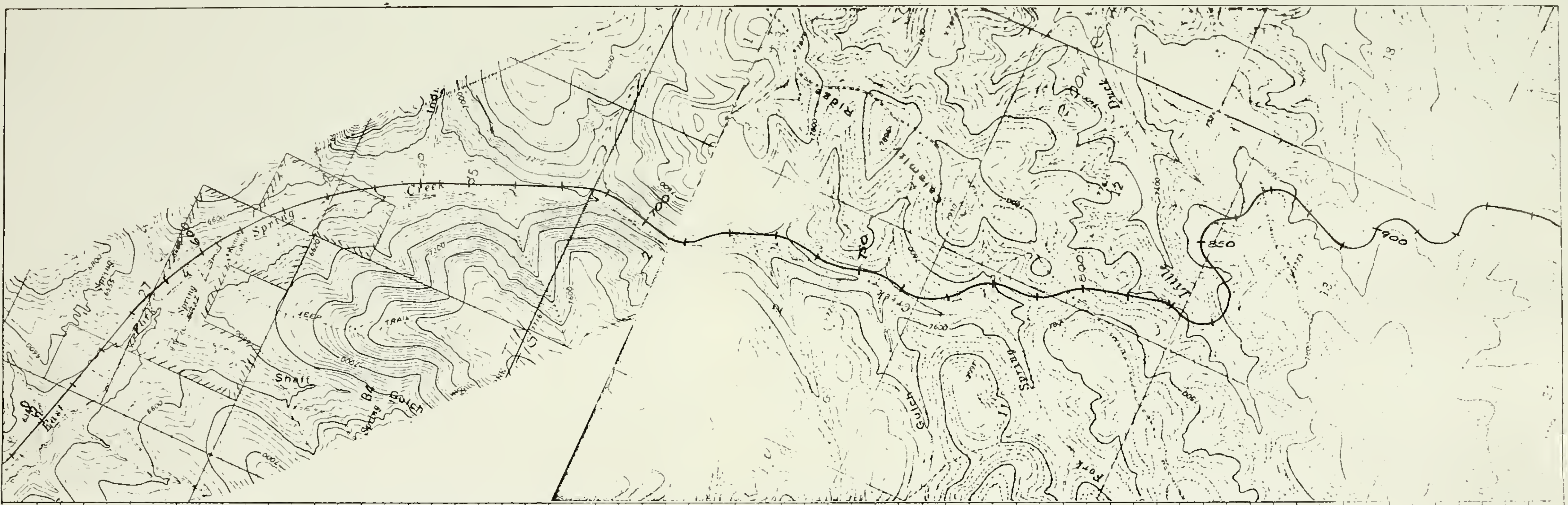


PLATE 1 PLAN PROFILE 1 A &
CLEARPRINT PAPER CO. S F CAL

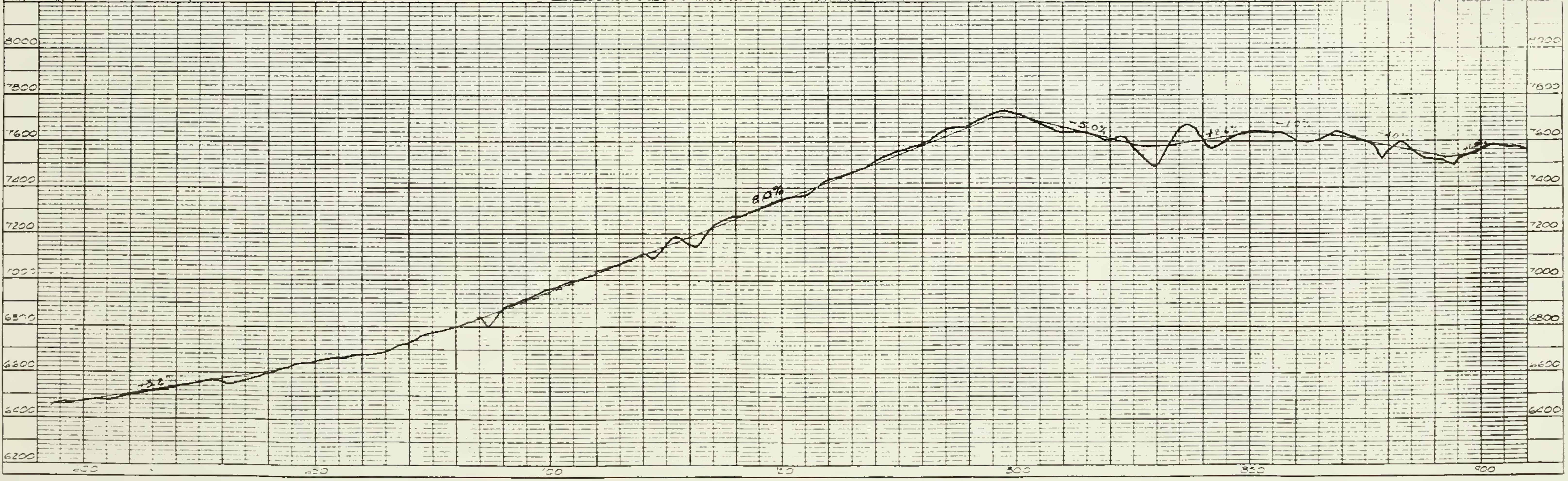
Route 9


PLAN
PROFILE
E.01W E.00W
TIN
Creek
Canyon
East Fork
Spring
Shaft
TRAIL
JEEP
18
20
21
22
27
28
250
300
350
400
450
500
550
600
6200
6400
6600
6800
-6%
-8%
+2.5%
+1.77
+3.8
+2.0
6300
6200
6000
5800
5600
5400
5200
350
400
450
500
550
600
PLATE 1 PLAN PROFILE
CLEARPRINT PAPER CO. S.F. CAL.
Route 9

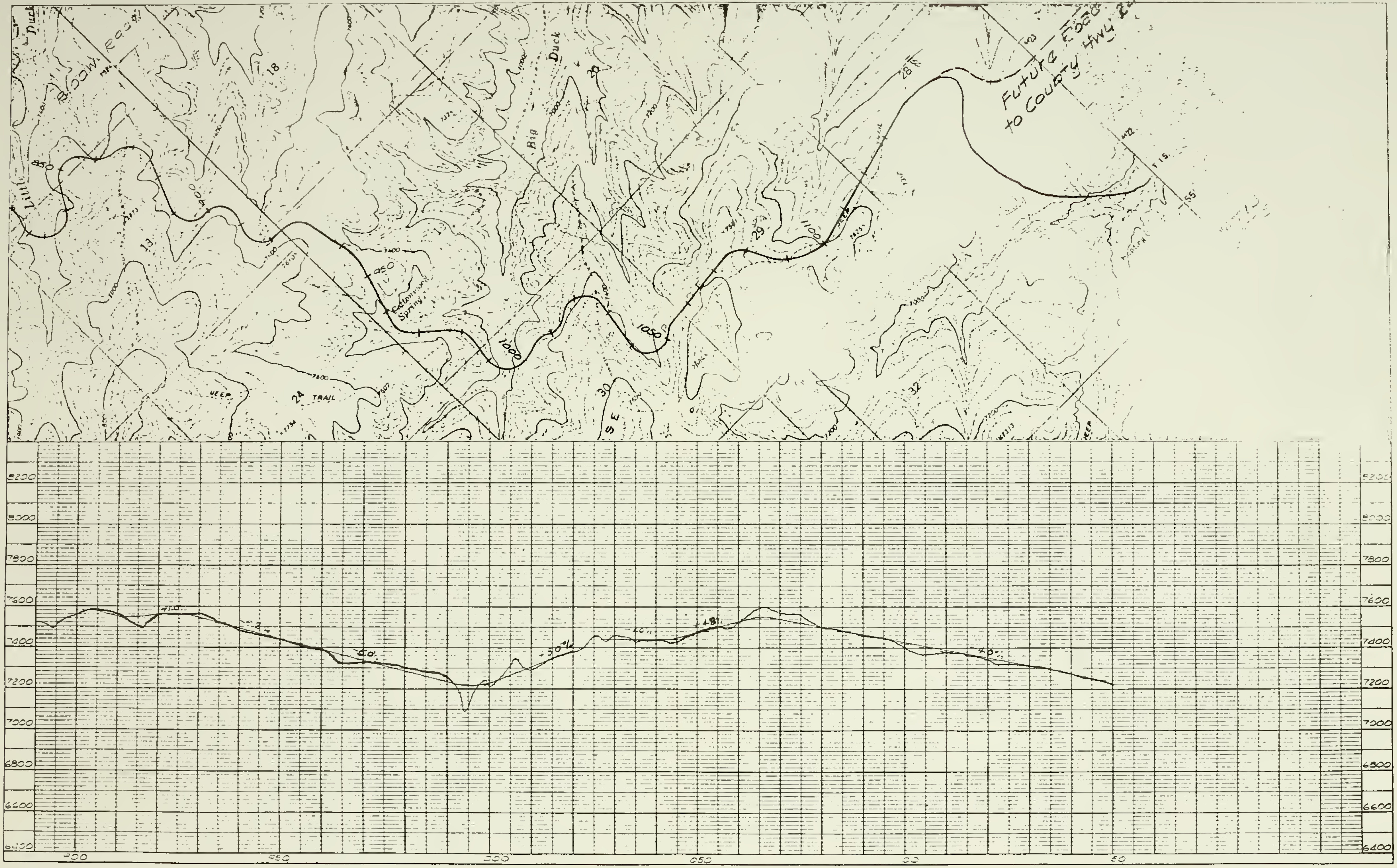
PLAN

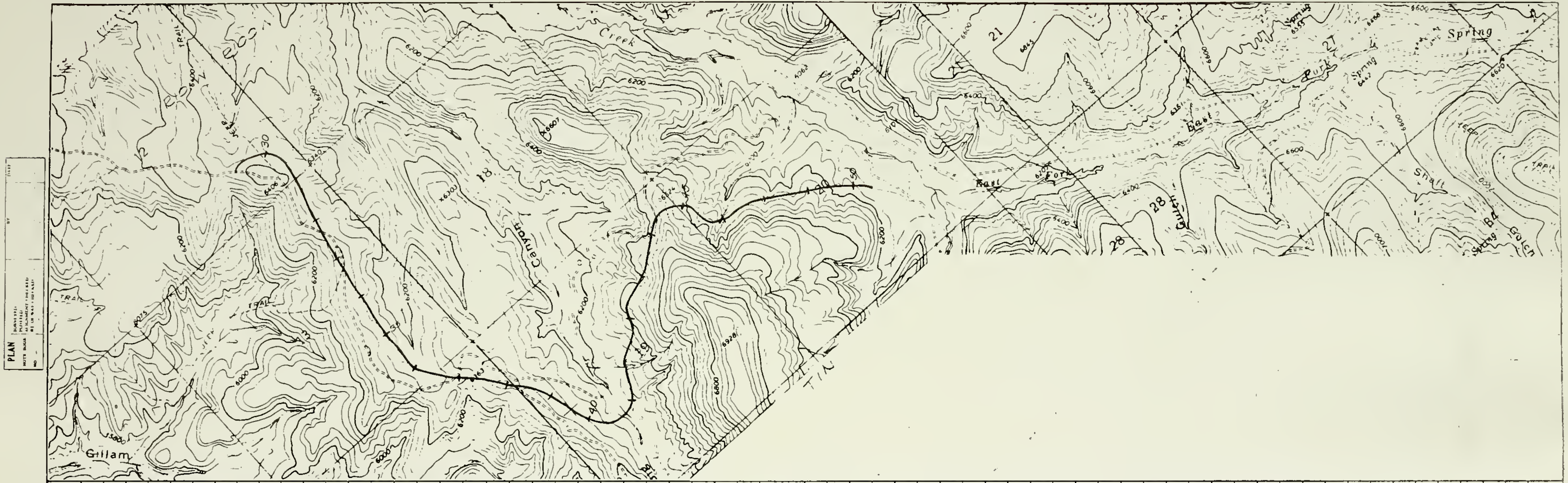


PROFILE



Route 9


Little Duck
Bloom Road
18
Big Duck
20
13
850
900
950
1000
1050
1100
Cottonwood Spring
24
JEEP TRAIL
JEEP
30
SE
29
28
32
Future Road to County Hwy 2d
T 15
55'
8200
8000
7800
7600
7400
7200
7000
6800
6600
6400
+1.0
-2.3
-5.0
+3.0%
-2.0
+4.8
-4.0
900
950
1000
1050
1100
1150



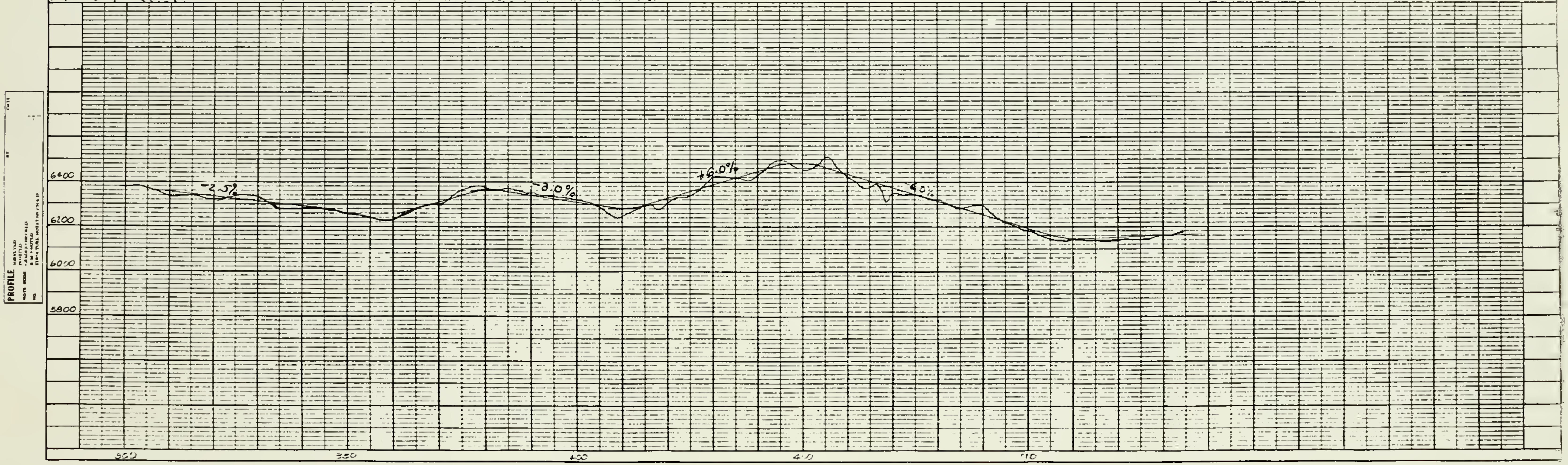


PLATE 1 - PLAN PROFILE F.A.S.
CLEARPRINT PAPER CO. S.F. CAL.

3. Geology

The geology of this route is similar to the other locations studied and is explained in more detail in a separate geology report. Basically, the rock encountered is sandstone or shale, with some intermixing of the two reported. As the dip of the rock layers is toward the south, any tendency toward slippage would be more critical on the north slopes. However, as the dip is not great, this would be of concern only in very high cuts.

The mantle on the talus slopes appears to be quite thin, overlaying weathered rock. Relatively steep cut slopes should be little problem with the exception of a normal amount of surface raveling.

4. Cost

The estimated construction cost for this route was based on unit costs compiled by Colorado Department of Highways and converted into per mile costs for the various types of terrain encountered. The costs were inflated to a January 1976 base.

It is estimated that there will be 6.3 miles costing $261,150 per mile and 14.4 miles at $522,300 per mile and one mile at $1,044,600 per mile, including the bridge at Big Duck Creek for a total of $10,210,965. Although there will be some right-of-way costs on this route, the above amount should cover this item.

Additional maintenance cost for this route based on $1,350 per mile per year would total $29,295.

5. Travel Time

It is estimated that design speeds of 55 mph can be maintained for the full length of Route 9. Based on an average running speed of 50 mph, the trip between Rangely and the plant site would be 30 minutes.

B. Proposed Route - Big Ridge Route 3

1. Description

(a) Route Log - This route utilizes the same alignment as Route 9 for the first three miles, beginning at Station 00 at a point three miles east of Rangely. The line departs from Colo. 64 in a southerly direction, crossing the flats for 3000 feet, then proceeding up Gillam Draw on the east side of the main channel to Station 160. At this point the line departs from Route 9. It continues up the north side of Gillam Draw to Station 275, where it ascends the east side of the canyon on a 7 percent grade. It crosses the north end of Big Ridge at Station 420, then proceeds up the west face of the ridge, still on a 7 percent grade, until it reaches the top of the ridge at Station 550.

From this point the line follows the top of Big Ridge to Station 750 then circles a peak, following the contour to the saddle at Station 775. From this saddle, the line climbs on the east side of the ridge at a constant 8.5 percent grade to Station 900, where it crosses the ridge and circles the peak on the west side of Cathedral Bluffs. Crossing the Bluffs requires an extensive cut (up to 60 feet) at Station 912.

From the top of Cathedral Bluffs the line descends Dead Horse Ridge generally on grades in the 3-5 percent range. At Station 1220 the line circles the end of Dead Horse Ridge and continues down the low hill to the plant site at Station 1290.

(b) Exposure - To minimize winter maintenance costs, an attempt was made on the road location to keep the road on the ridges or on slopes exposed to the sun and, where possible, in line with the prevailing wind or on the windward side of the hills. Route 3 being principally a ridge type location has basically good exposure. However, between Stations 780 and 900 (where grade considerations were paramount), the location of the route is on the shady side of the slopes.

(c) Effect on the State Highway System - This route would have the same effect on the State Highway system as Route 9, which would probably be limited to additional signing at the Gillam Draw turnoff.

(d) Effect on the Terrain - Assuming adequate design of the roadway cut and fill slopes and proper seeding, there are only two sections of this route which could significantly affect the terrain. One is between Stations 70 and 110 in Gillam Draw where there may be conflict between the route location and the stream. Some channel changes may be necessary and considerable rip-rapping and possibly other types of channel protection are anticipated due to the highly erosive quality of the soil. The other location is between Stations 430 and 518 (and also at Station 900) where the road is located on the westerly slope of Big Ridge. The scar made by the new construction may be visible from State Highway 139.

(e) Right of Way - With the exception of the first one-quarter mile immediately south of State Highway 64, all of the lands traversed by Route 3 are public and are under the jurisdiction of the U. S. Bureau of Land Management. The right-of-way required will vary throughout the length of the route. There are no conflicts on this route with any public utilities.

2. Alignment and Profile

The attached plan-profile sheets were prepared using enlarged portions of USGS quadrangle sheets for plan background. The ground profile was taken from the contours of these maps.

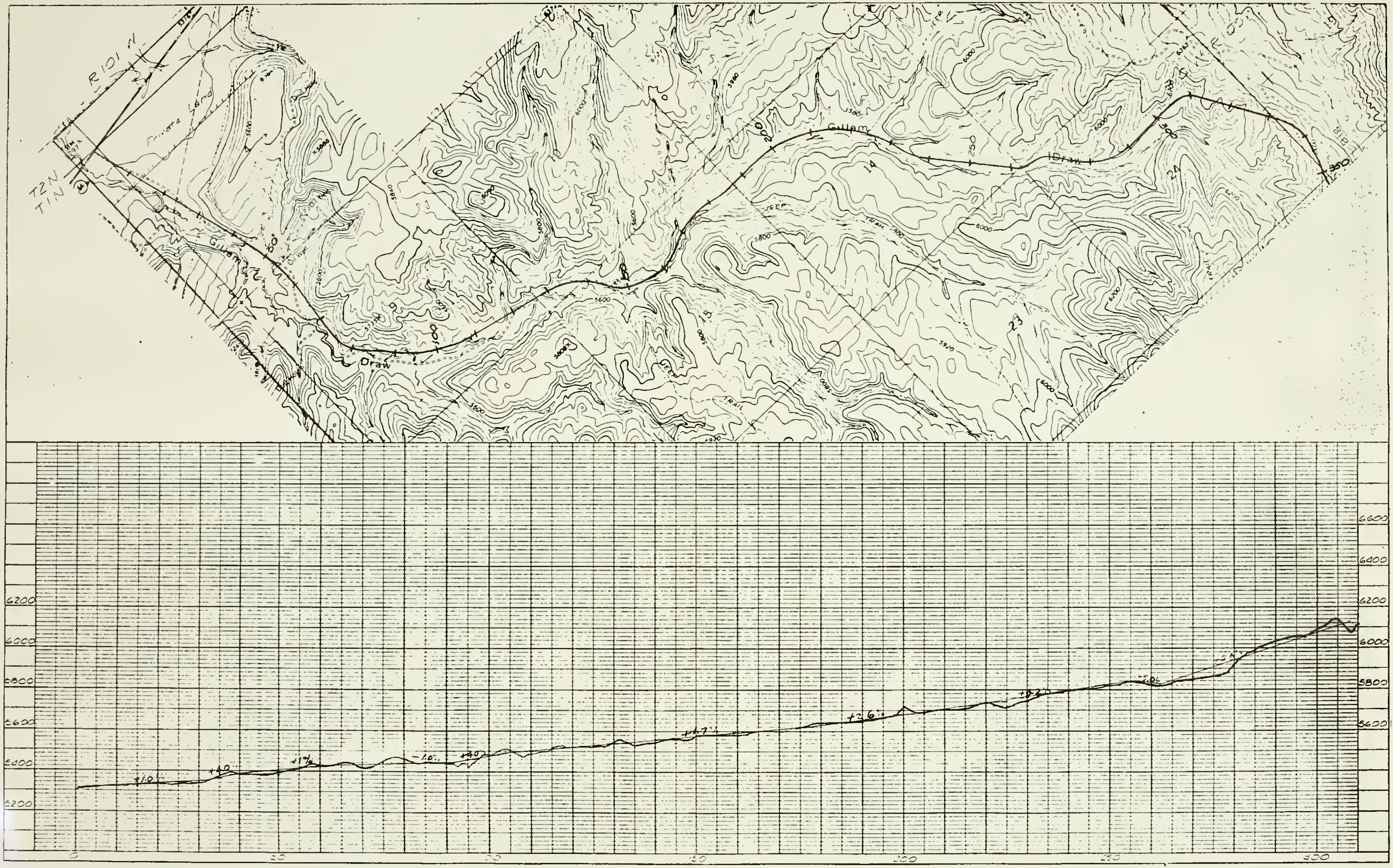
The alignment was based on the optimum grade and horizontal curvature possible for the terrain traversed.

On Route 3, it appears possible to keep the radius of all horizontal curves at 600 feet or greater. The following table shows the approximate mileage for various grades on this alignment:

Grade	Distance
0 - 4%	5.5 mi.
4 - 6%	9.9 mi.
6 - 8%	6.3 mi.
Over 8%	2.7 mi.
	24.4 mi.

3. Geology

Route 3 geology should be very similar to that currently exposed on the Calamity Ridge road. Following the ridge as it does should mitigate most problems of adverse geologic condition. The deep cut


R101W
T2N
T1N
Private Land
Gillam
Draw
Oil Well
SEEP
TRAIL
14
15
23
24
50
100
150
200
250
300
350
5600
5800
6000
6200
+1.0%
+4.0
+1%
-1.0
+4.0
+1.7%
+2.6%
+2.2
-2.0
6600
6400
6200
6000
5800
5600
5400
5200
0
50
100
150
200
250
300

Route 3

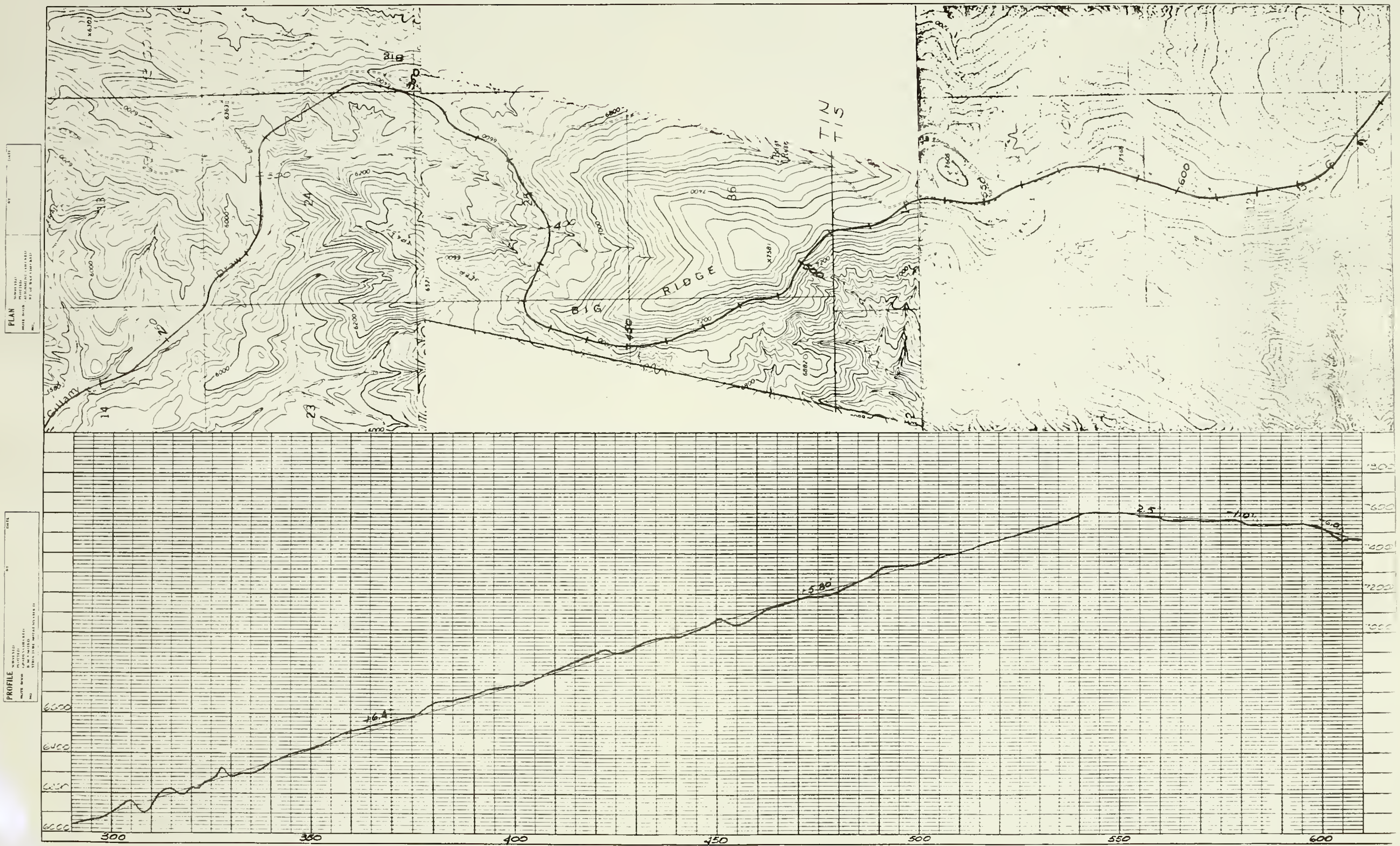


PLATE 1 PLAN PROFILE F.A.8
CLEARPRINT PAPER CO. S F CAL
NO 1000H 1

Route 3

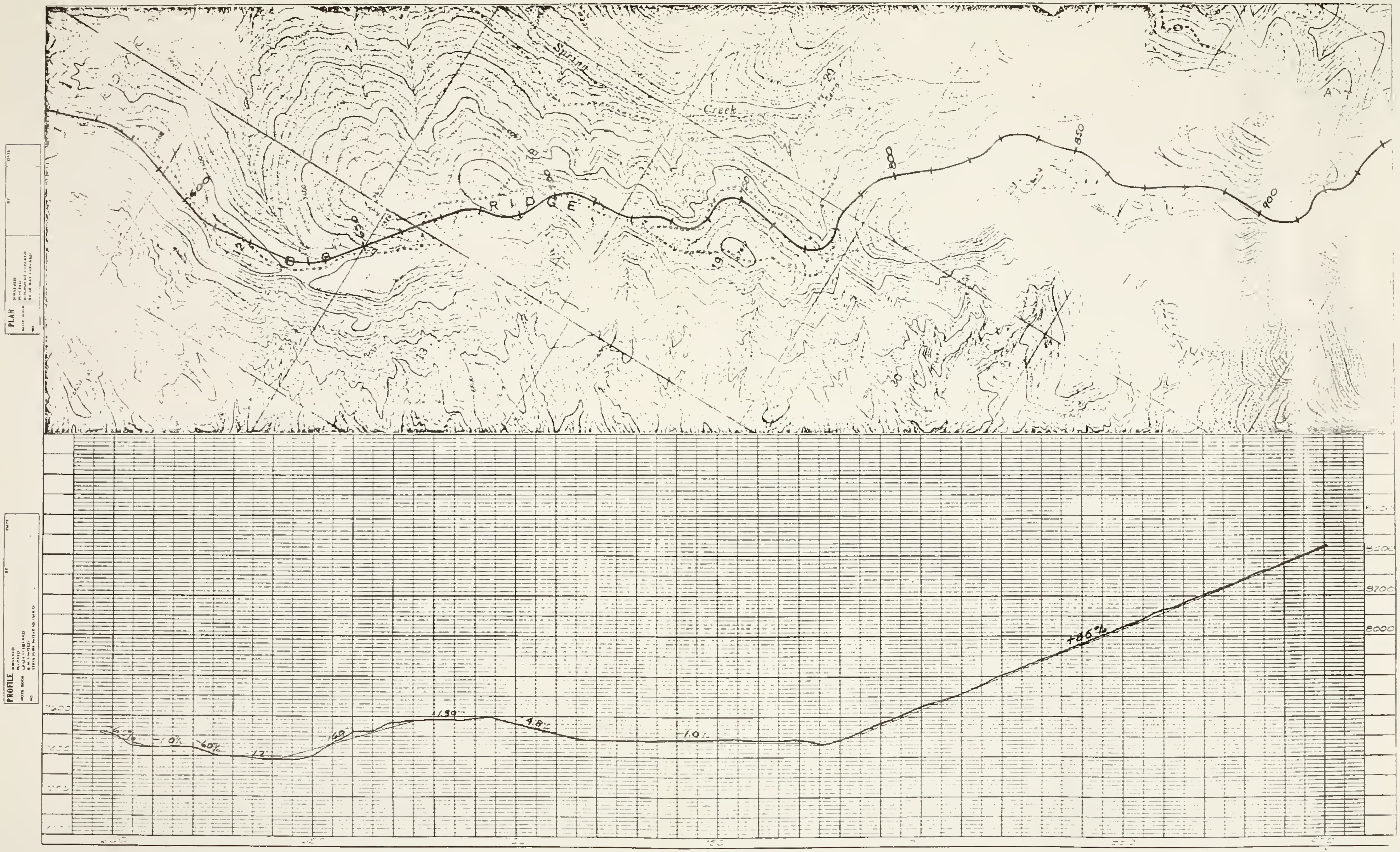
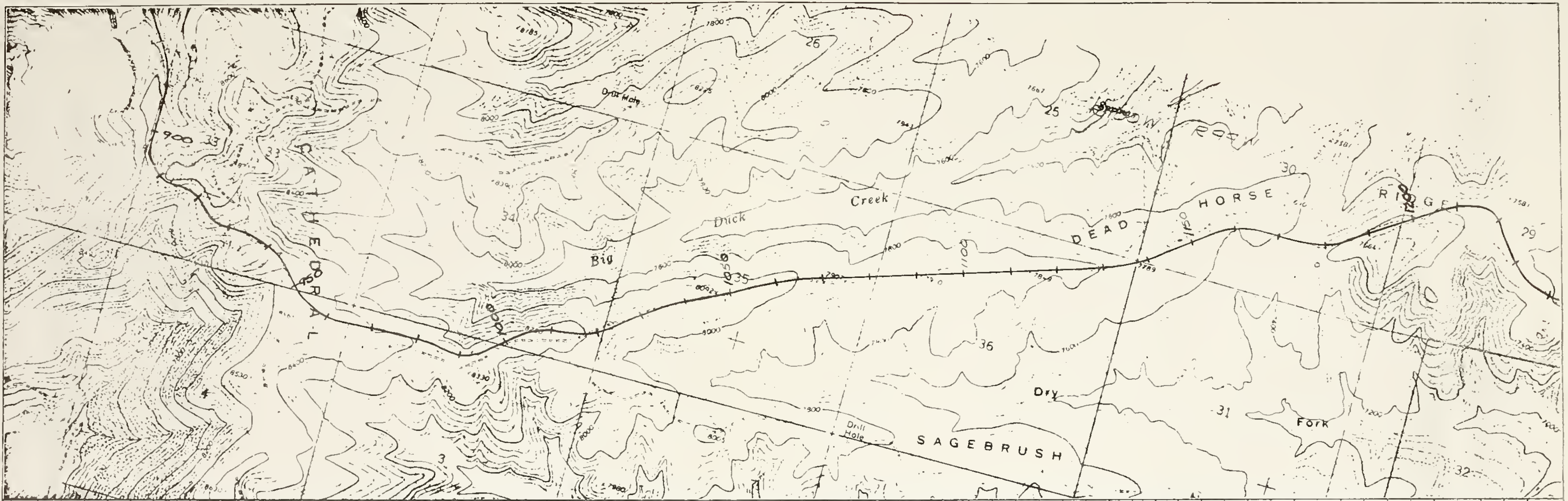
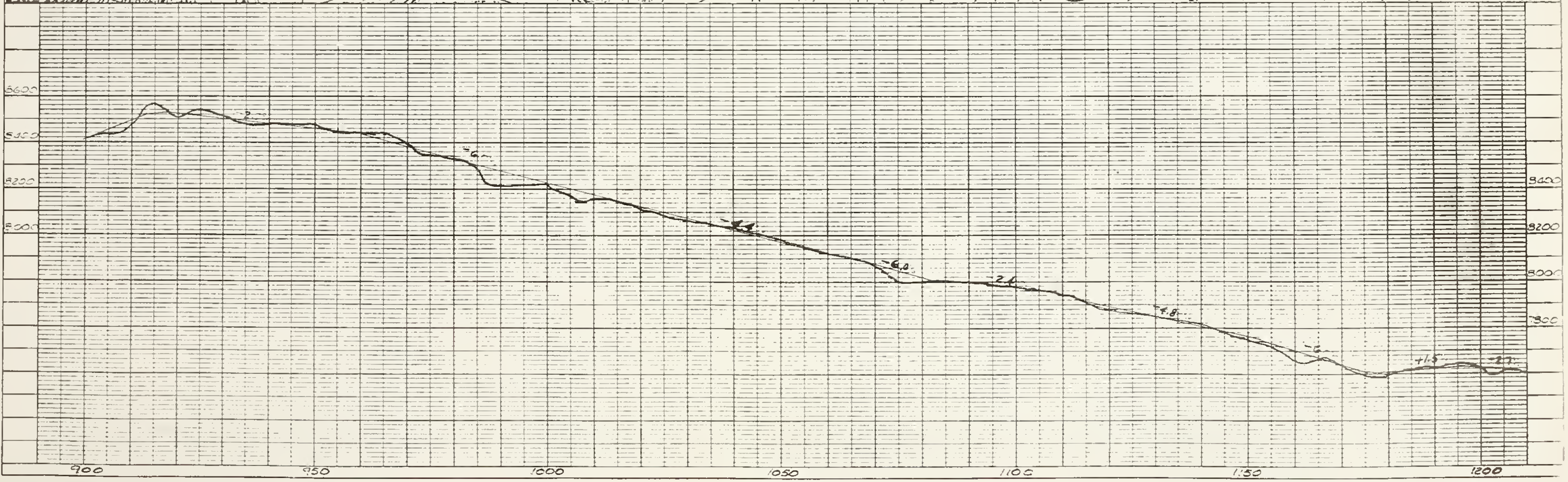


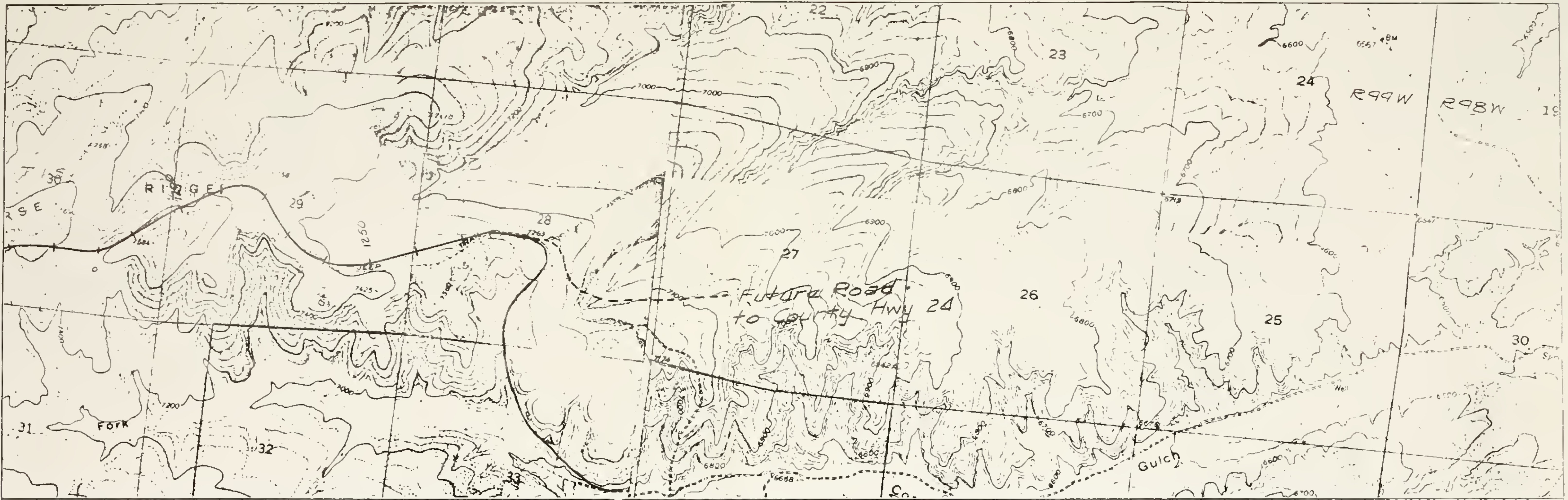
PLATE I PLAN PROFILE F.A.S.
CLEARPRINT PAPER CO. S.F. CAL.
NO. 1000H-1

Route 3


PLAN
900
33
CATHEDRAL
34
Big
Duck
Creek
26
25
DEAD HORSE RIDGE
1200
1150
1100
1050
1000
950
30
29
35
36
Dry Fork
31
32
SAGEBRUSH
Drill Hole
3
4


PROFILE
8600
8400
8200
8000
7800
-2
-6
-4.4
-6.0
-2.1
-4.8
-6
+1.5
-2.7
900
950
1000
1050
1100
1150
1200

Route 3



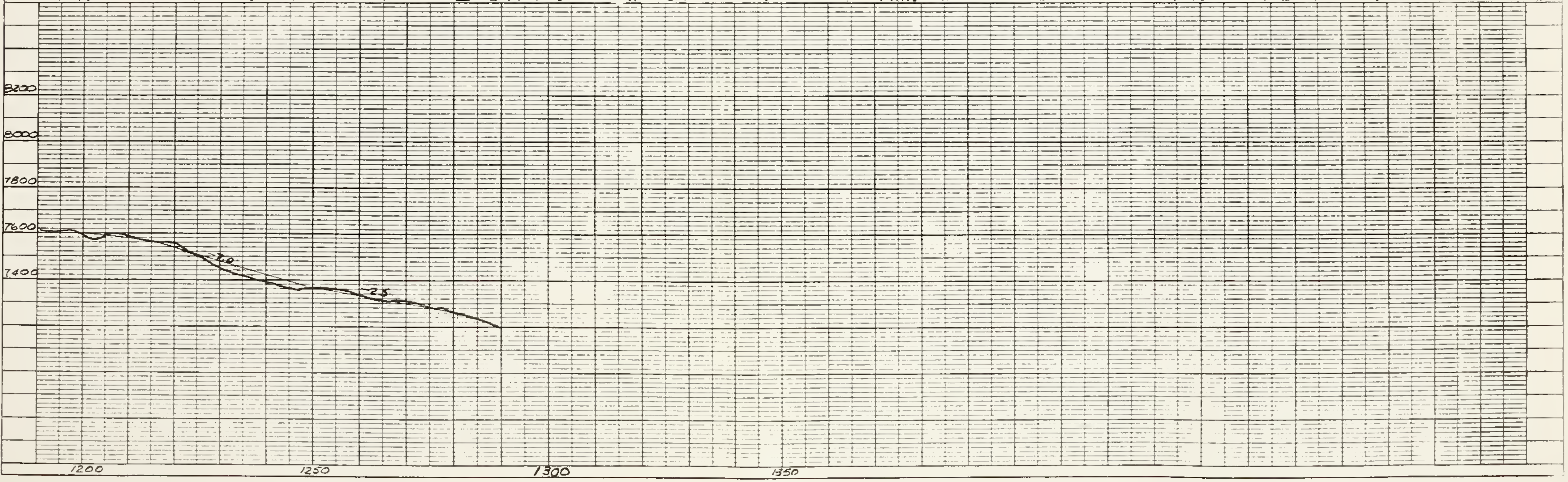


PLATE 1 PLAN PROFILE
CLEARPOINT PAPER CO S.F. CAL.
NO 1000H 1

Route 3

through Cathedral Bluffs at the summit, although across the general dip of the bedding, should not be a serious problem because of its high position in the formation.

4. Cost

Costs were estimated for Route 3 in the same manner as previously described. The estimated construction cost for Route 3 was 5.2 miles at $261,150 per mile; 16.1 miles at $522,300 per mile; and 1.5 miles at $1,044,600 per mile for a total construction cost of $11,333,910.

Based on an average annual cost per mile of $1,350, the annual maintenance cost for the 23.4 miles of new construction was computed to be $31,590 per year.

5. Travel Time

It is expected that this route could be designed for a speed of 55 miles per hour. With the exception of the section of road between Station 780 and 910, all of the grades are 8% or less and the horizontal alignment has degrees of curve of 10° or less. Assuming a 5 mile per hour reduction in speed for the 13,000 feet of 8.5 percent grade, the average running speed (using AASHO design data) from Rangely to the C-a plant site is 48 miles per hour. The trip time was calculated to be 34 minutes.

C. Calamity Ridge Route 8

1. Description

(a) Route Log - This route begins at Station 00 at a point 10.0 miles northeast of Rangely on Colorado 64. The present intersection is

slightly below the top of a vertical curve and on the inside of a 4 degree horizontal curve in a cut approximately 5 feet deep.

From Station 00 to Station 190 the alignment follows the existing 18-20' unpaved road ascending the low ridge between Quinn and Priest Draws on 4 - 5 percent grades with occasional short sections of 7 percent. The alignment in this section consists of short tangents connected by short 300' - 500' radius curves.

At Station 190 the road ascends on a 1000 foot 8 percent grade to the ridge between Spring Creek and Fletcher Creek. From this point to Station 350 the road traverses the ridge on fairly long tangents with gentle horizontal curves and relatively moderate grades. From Station 350 to Station 500 the road climbs the north side of the hill on 6 - 8.2 percent grades with fairly good alignment with some minor deviations to avoid natural obstacles. From Station 500 to Station 750 (where it intersects Calamity Ridge), the road alternately crosses from north to south sides of the ridge in side hill cuts to maintain 7 - 8 percent grades. There are a few steeper grades (up to 12 percent) on short 200 - 300 foot sections. Through this portion, the horizontal curvature of the road ranges from 200 - 400 foot radius curves with two of the curves at Stations 562 and 590 traversing the sharp points of the mountains on 100 foot radius curves.

At Calamity Ridge the route leaves the existing road and descends into Trail Canyon on an 8 percent grade and a 500 foot horizontal curve. From Station 800 to Station 930 the route follows the drainage channel on the north side on a constant 6 percent grade

with very good alignment. At Station 930 the terrain flattens to an approximate 2 percent grade to Station 1092 where the line crosses Little Duck Creek.

At Station 1105 the line crosses Big Duck Creek, then ascends the very uniform slope on 2 to 4 percent grades and long, horizontal tangents to the proposed plant site at Station 1310.

(b) Exposure - The general direction of this road is with the prevailing winds which should aid in reducing winter maintenance problems.

Being located along a ridge for the first fourteen miles from SH 64 to Calamity Ridge, this section of the road will be exposed to the sun with the exception of the portion between Stations 430 and 550 where the existing road climbs the north side of the hill.

The section descending Trail Creek would be located near the bottom of a relatively narrow canyon, but on the north side. From the crossings of Little and Big Duck Creeks, the road would be in open terrain with good exposure to the sun and wind.

(c) Effect on the State Highway System - The effect on the state highway system would be the same as for the previously described routes, except that the increased traffic on State Highway 64 would extend 10 miles east of Rangely rather than 3 miles,

As pointed out in the route log, some improvements to the intersection of the Calamity Ridge access road and State Highway 64 would be necessary to provide for the increased traffic at this intersection. It is anticipated that the increased amount of traffic on State Highway 64 would have some increased effect on

the capacity and the maintenance cost of the road. Restoration of this section of State Highway 64 might be required at a later date.

(d) Effect on the Terrain - The first fourteen and one-half miles of Route 8 would follow the existing BLM road over the ridges and would not disturb any additional terrain except increasing the size of the cut faces and fill slopes due to the widening of the road.

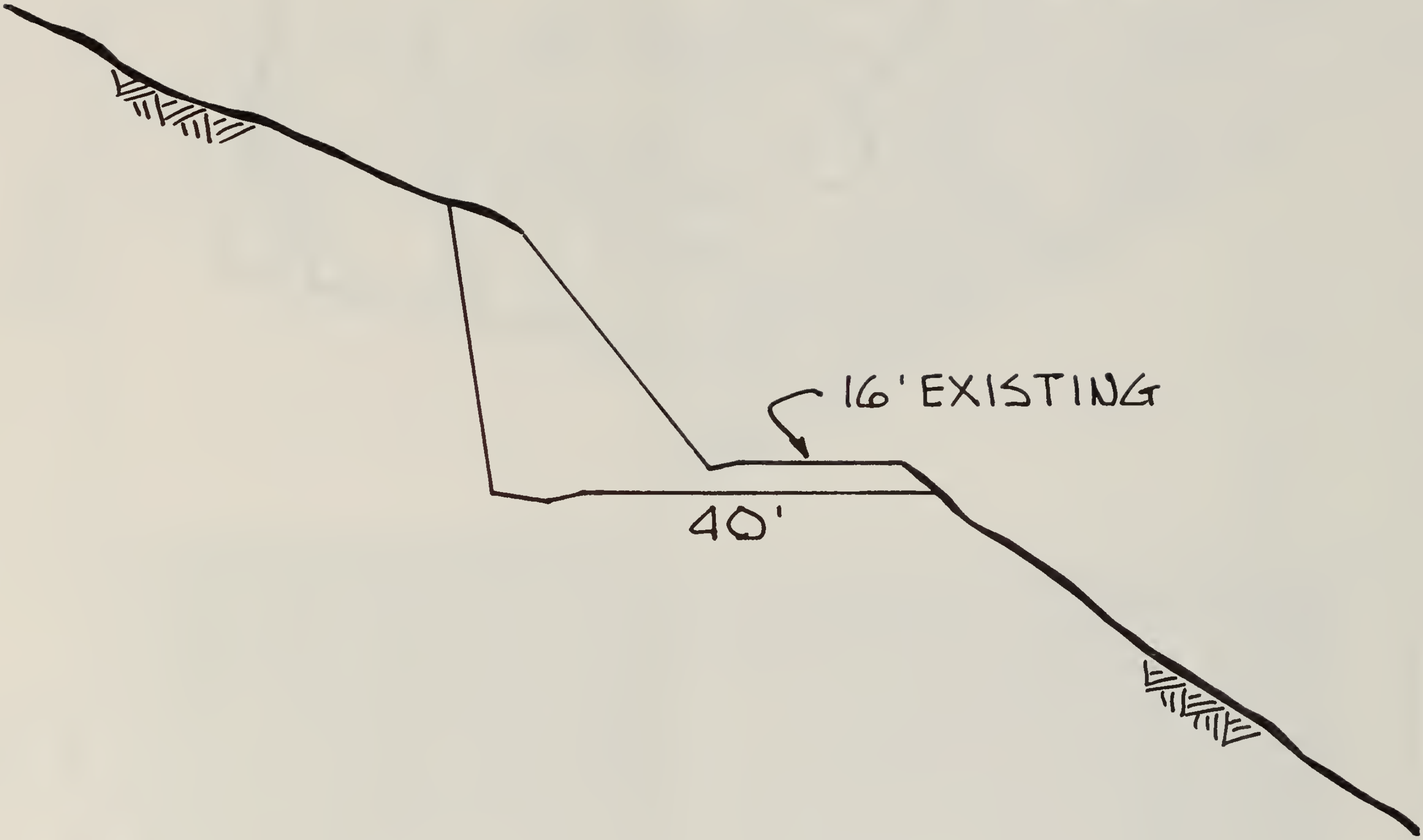
Ground reconnaissance in Trail Canyon indicated that there is sufficient room to construct a road in this location without encroaching on the stream. From the Duck Creek crossings the route follows a low ridge to the plant site with little or no harmful effects to the natural terrain.

(e) Right of Way - The entire length of Route 8 would be on public land under the jurisdiction of the U.S. Bureau of Land Management, with the exception of one quarter mile of private land at the junction of Big and Little Duck Creeks. This land could be circumvented with little added distance to the route if necessary.

There are no conflicts with the existing utilities on the route.

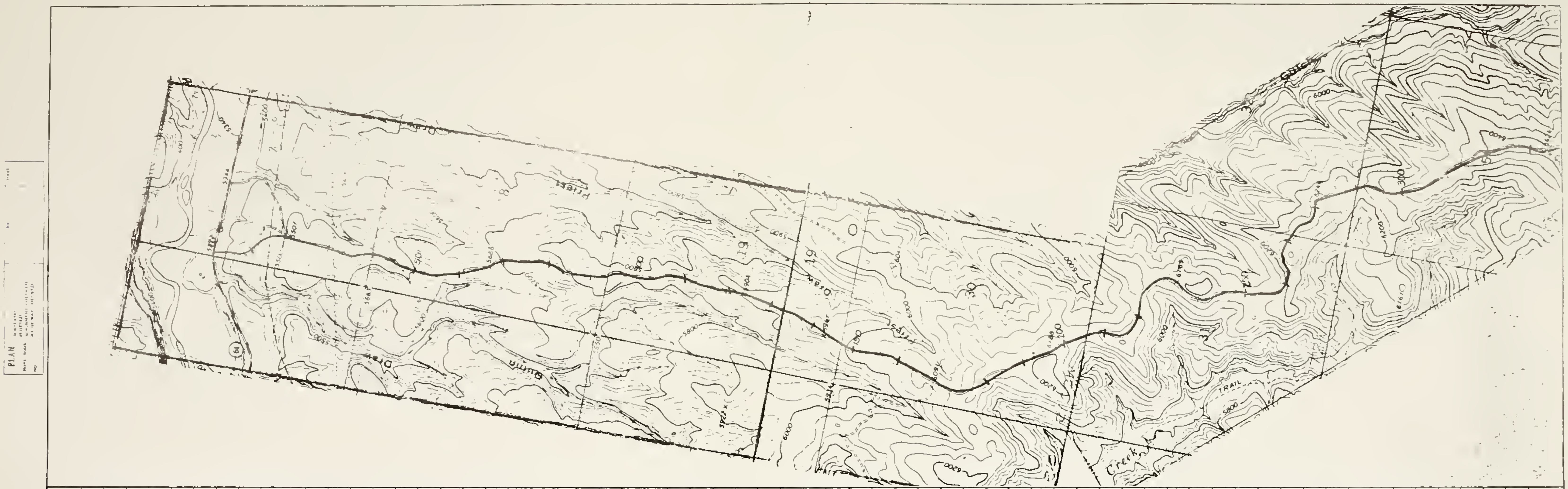
2. Alignment and Profile

The attached plan profile sheets depicting this route were prepared from USGS mapping. The location and profile of the recently constructed portion of the existing BLM road from Station 448 to Station 730 was obtained from the bidding plans for the construction project.



— IMPROVEMENT —

CALAMITY RIDGE ROAD



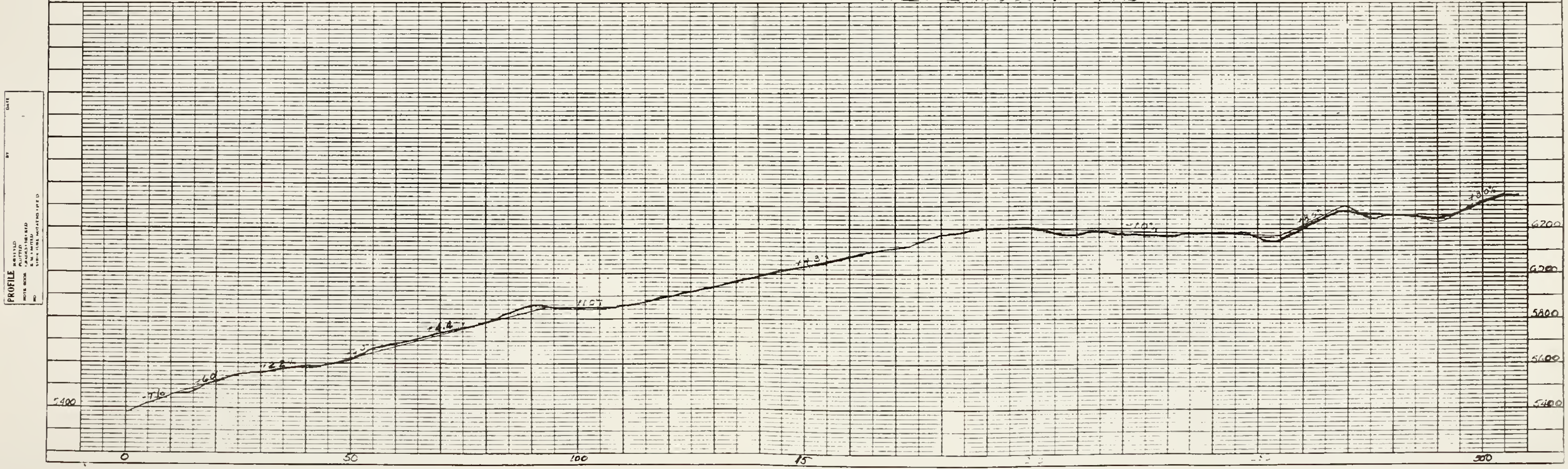
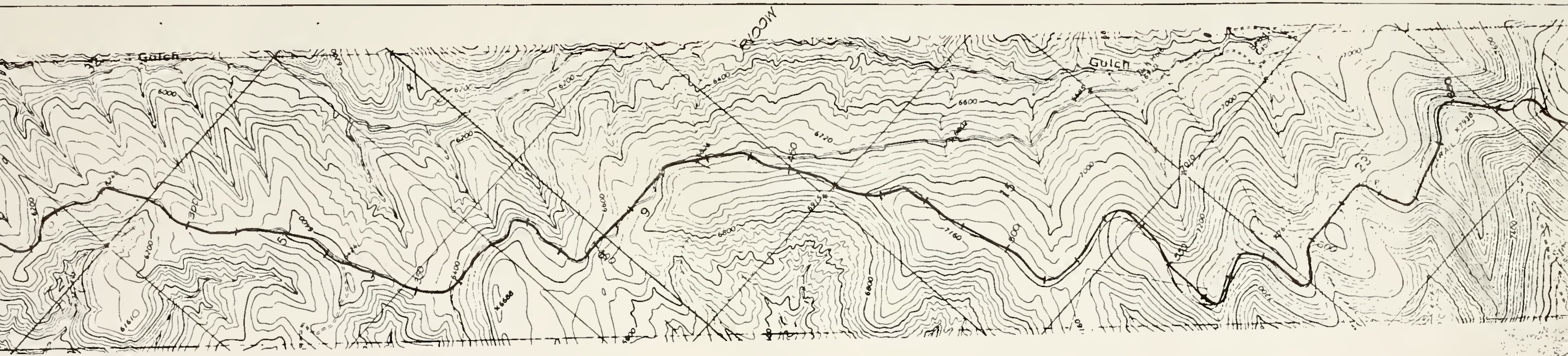
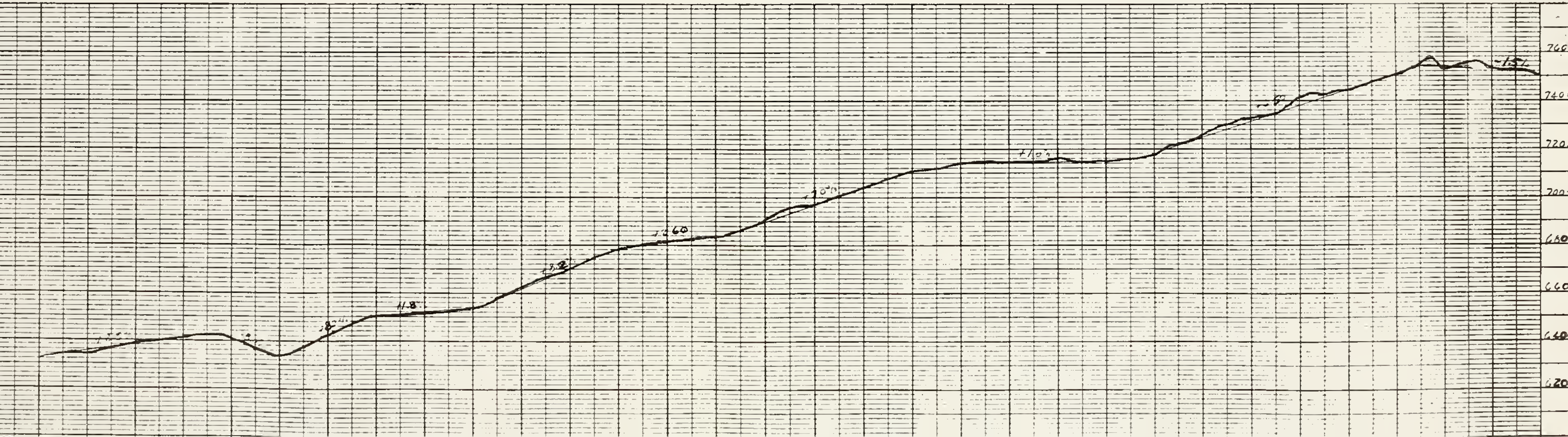
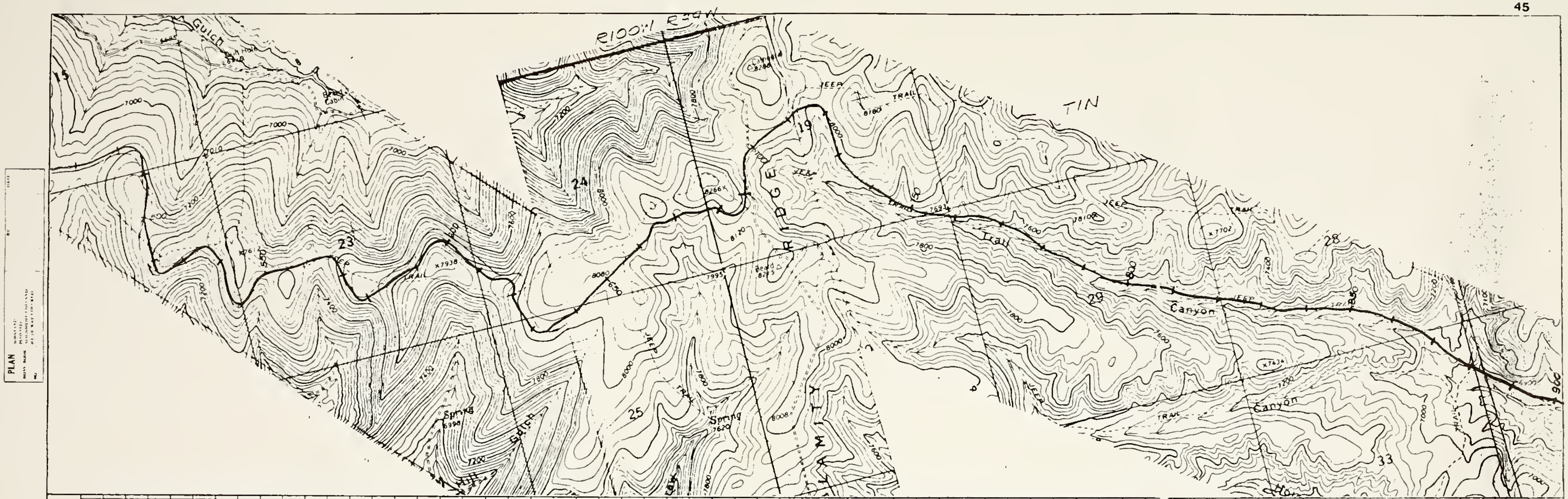


PLATE 1 PLAN PROFILE / A B
CLEARPRINT PAPER CO. S F CAL
NO. 1

Route 5


Gulch
WOOD
Gulch
6000
6200
6400
6600
6720
6800
7000
7160
7200
300
5
9
15
23


760
740
720
700
680
660
640
620
1.8
+1.60
-1.5



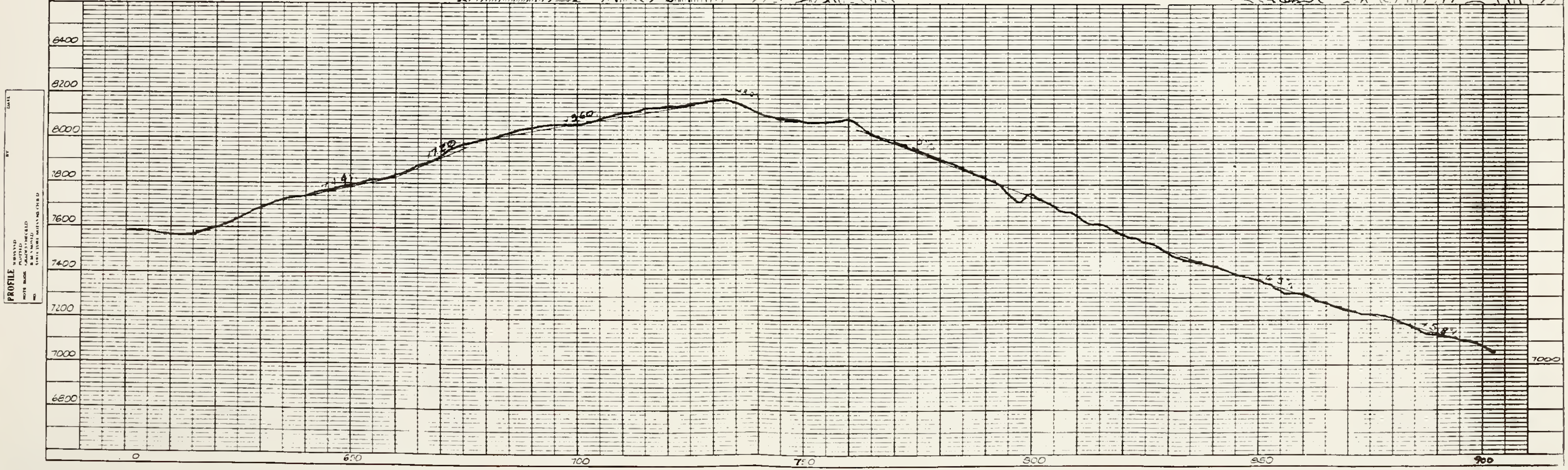
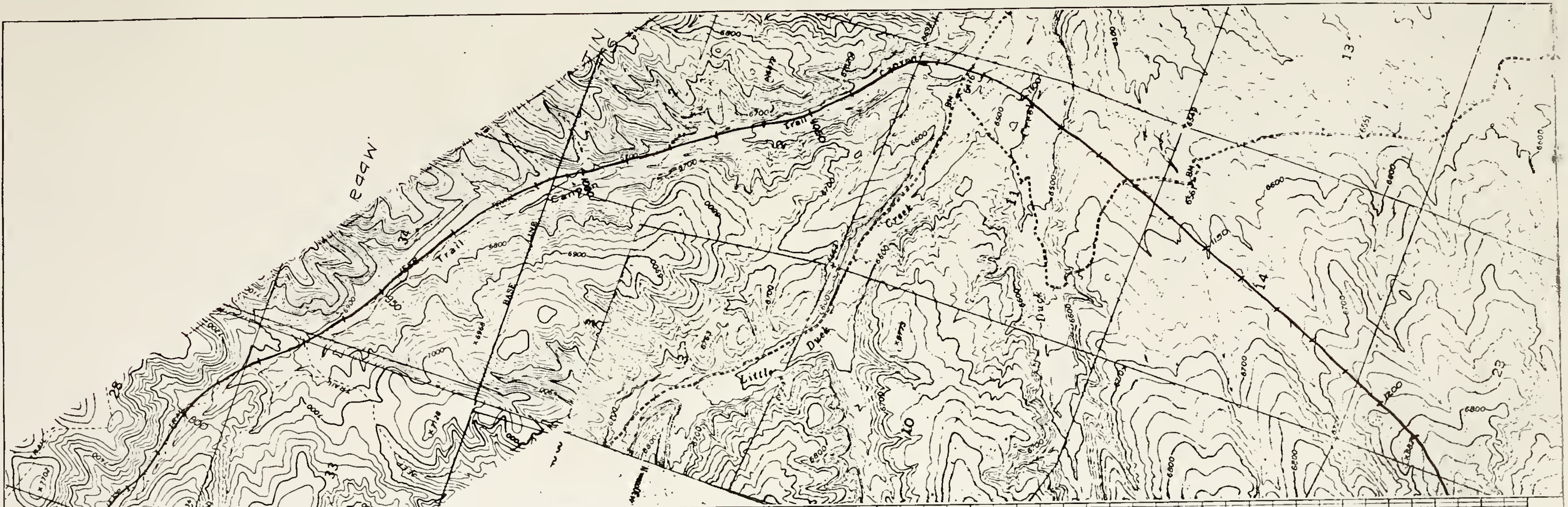


PLATE 1 PLAN PROFILE F & B
CLEARPRINT PAPER CO. S.F. CAL.
NO. 1000H 1

Route 8

PLAN



PROFILE

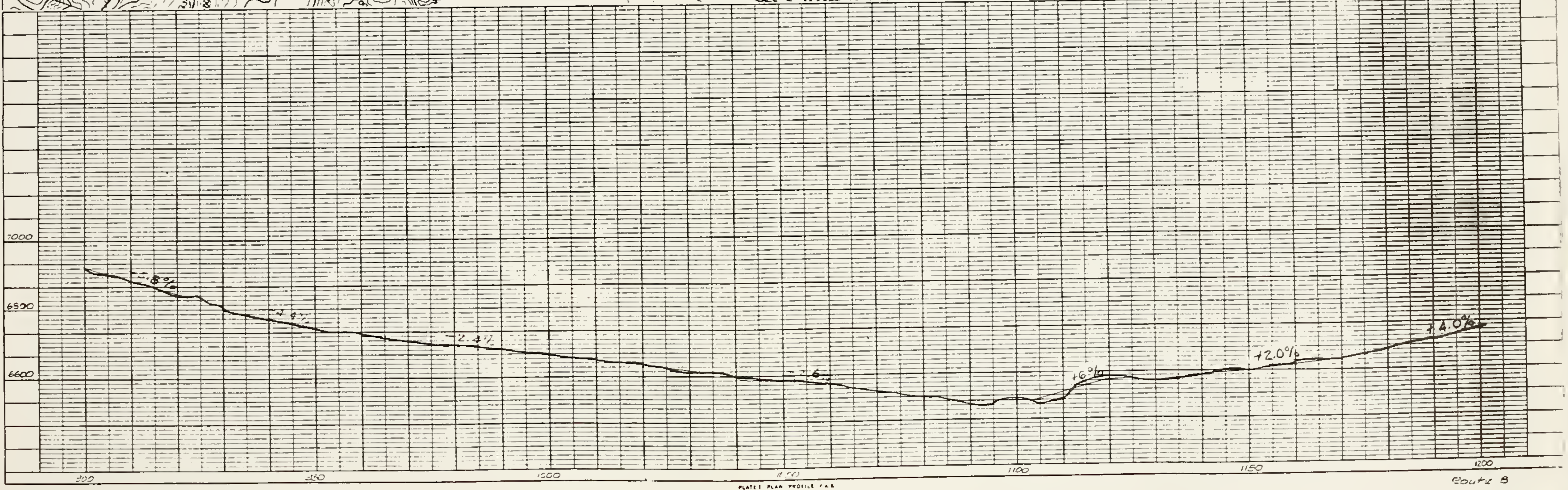


PLATE I PLAN PROFILE / A B
CLEARPRINT PAPER CO. S F CAL
NO [illegible]

Route 8

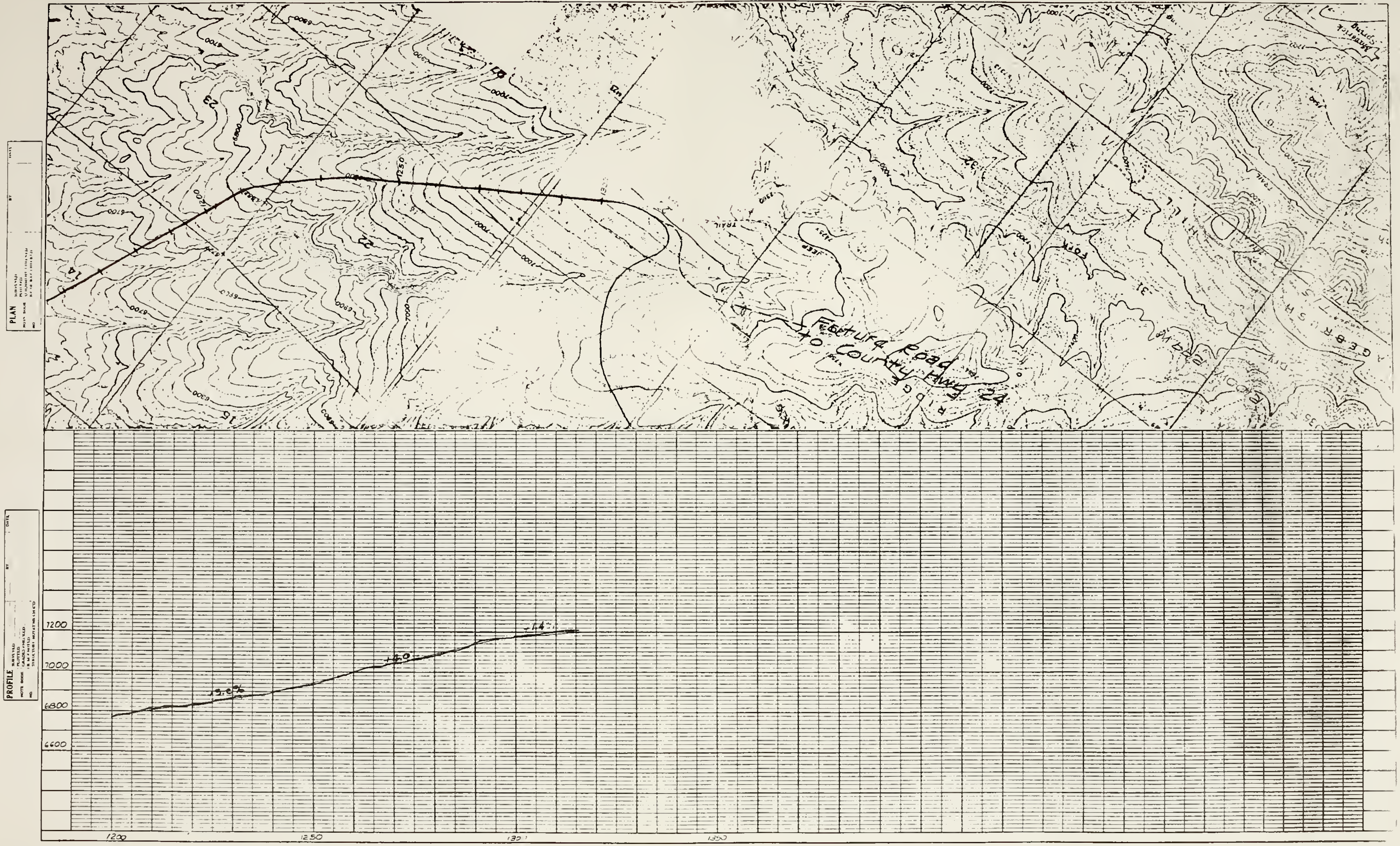


PLATE 1 PLAN PROFILE
CLEARPRINT PAPER CO.

Route 3

To provide for the volume of traffic anticipated on this alternative route it would be necessary to improve the intersection with Colorado 64. This could be accomplished by moving the intersection approximately 500 feet west to the top of the vertical curve and/or flattening the cut slopes on Colorado 64.

From Station 00 at Colorado 64 to Station 350 there would be little difficulty using the approximate alignment of the existing road for an improved road. By flattening curves and making minor adjustments in grade, the right-of-way of the existing road could be saved. However, there would be only a negligible amount of construction salvage value of the existing roadway. Design standards for 55 mph traffic could be maintained through this area.

From Station 300 to Station 500 where the grades are higher and the existing curvature sharper, a new alignment would follow the existing road by shifting the centerline into the hills on side hill cuts and flattening out many of the sharper curves. In almost all instances, flattening the curves would result in higher grades due to reduction in length. This would make the grades higher on the sharp curves, which is contrary to the normal procedure of compensating grades on sharp curves. The salvage value of the road would be limited to the right-of-way, a very minor amount of the excavation quantities, and access to the construction site.

From Station 500 to Station 750 the above situation recurs except the grades, curvature, and natural terrain are heavier and more critical. As the existing roadway is generally a full bench cut into the hill, it would

be necessary to shift the centerline a minimum of 10 to 12 feet into the hill. Furthermore, 100 foot radius curves exist at Stations 562 and 590. To provide a 30 mph design speed, the radii would need to be increased to approximately 250 feet which would place the new centerline 100 - 150 feet into the hill. This would increase the cuts on centerline 40 to 50 feet and increase the grades through the curves 1 to 1.5 percent or increase the grades on either end of the curves, due to the shortening. Salvage value of the existing road would be 10 - 15 percent of the grading quantities and the right-of-way.

From Calamity Ridge (Station 750) it would be necessary to introduce an 8 percent grade on a new alignment for approximately one mile to descend into Trail Canyon. From this point on to Little Duck Creek, the grade becomes progressively flatter.

After crossing Big Duck Creek the terrain is very uniform and on light grades for the four miles to the plant site.

The grades anticipated for this route would be

0 - 4%	6.7 miles
4 - 6%	2.1 miles
6 - 8%	15.8 miles
Over 8%	0.3 miles

The minimum curve radius on this route would be 250 feet.

3. Geology

The geological formation for Route 8 is essentially the same as for the other route previously described. The exposed cut faces on the section

traversing the approach to Calamity Ridge consist chiefly of shale. The existing cut slopes appear to be standing on 3/4:1 slopes with minor surface raveling.

4. Cost

The estimated construction cost for this route was prepared using the same criteria as for the other routes to develop a per mile cost for the various types of terrain traversed.

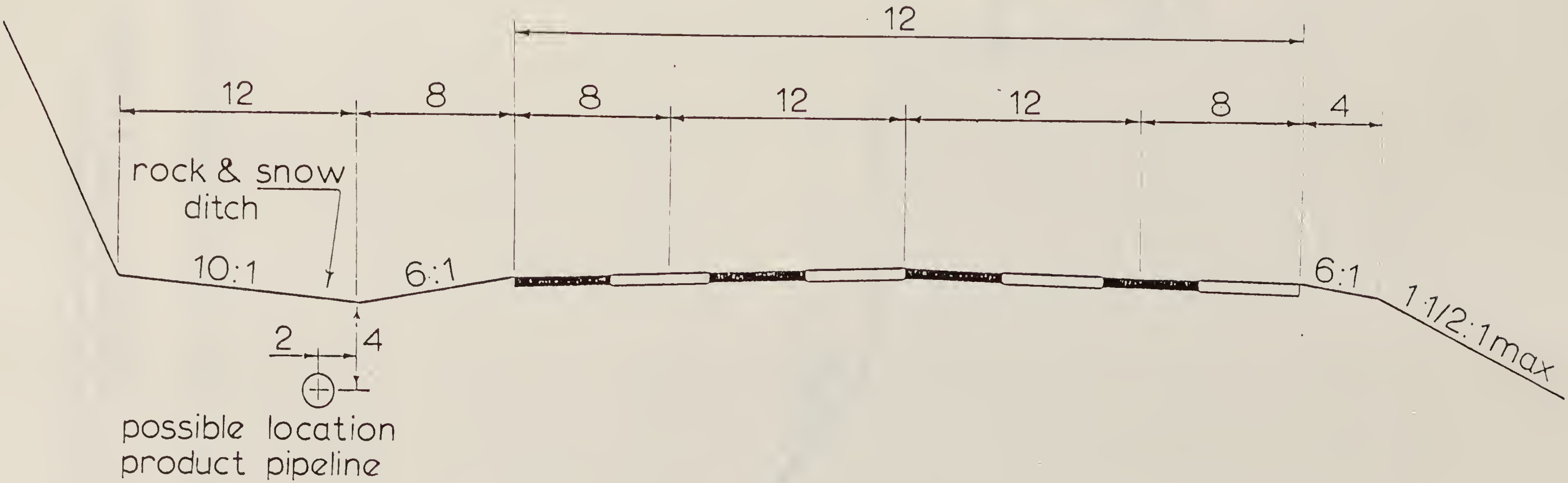
As the proposed typical section is over three times the width of the existing section in side hill cuts, the salvage value of the excavation made for the existing road would be a very minor part of that required in reconstruction. Also, because of the long haul, the paving costs would be a major item in the total construction cost of the project. For these reasons, no allowance in cost was given to the sections of existing road.

It is estimated that there will be 7.5 miles at $208,900 per mile and 16.9 miles at $500,000 per mile for a total cost of $10,393,620.

Additional maintenance costs for the section are estimated to be $32,940 per year.

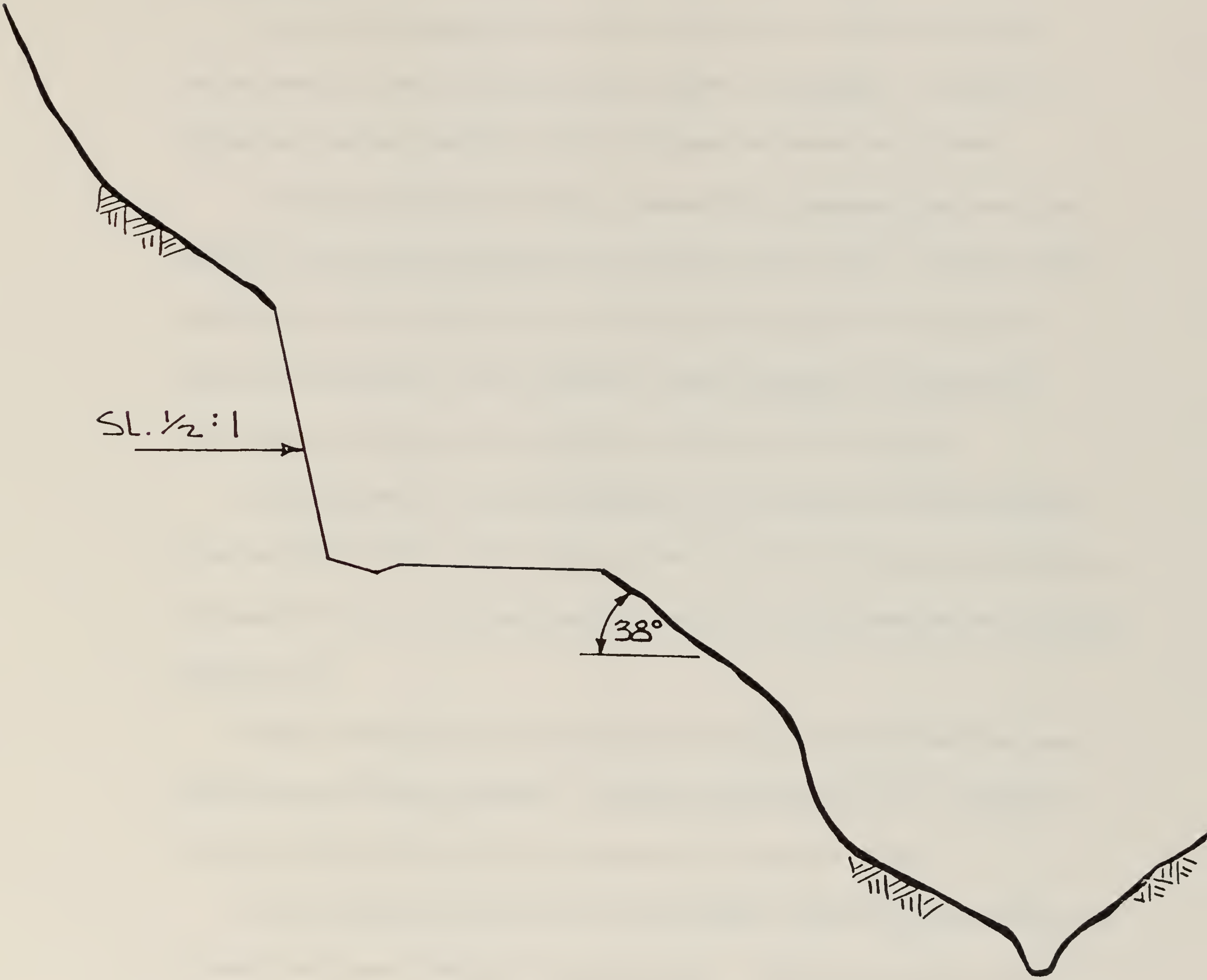
5. Travel Time

Travel time for this route was computed assuming design speeds of 30 mph on 8 miles and 55 mph on 26.9 miles. The travel time for a one way trip between Rangely and the C-a plant site was computed to be 49 minutes based on running speeds of 28 mph and 50 mph, respectively. The average running speed for the trip was computed to be 43 mph.



- TYPICAL SECTION -

SEE M-STANDARDS FOR DETAILS - PG 15 & 16



— REPRESENTATIVE SECTION —

SPRING CREEK CANYON

Benefit Cost Ratios

As a means of comparing the various alternatives, a ratio of the benefits derived versus the cost of obtaining those benefits was computed. To make this comparison, the base condition of all traffic going to Meeker was assumed.

In this base condition it is further assumed that an adequate road would be provided in this direction regardless of the Rangely direct route. Thus the cost of providing the base condition is zero. Although this assumption is not correct (because an investment in new facilities is actually required), the results are conservative, and each route comparison is in the same relative order.

Annual benefits of a route are defined as the savings over the base condition. Since the base condition is the vehicle operating cost for all travel to go to Meeker, the benefit of a route is the base condition minus the route alternative annual vehicle operating cost.

Table 7 summarizes one-way vehicular trip costs for each of the three route alternatives and the base condition. Vehicular operating costs were computed at 9 cents per mile and time costs were computed at 5 cents per minute.

Table 8 includes the results of the gravity model vehicular trip distribution and the associated annual road user costs and benefits. A 365-day year was used in the computation of costs and benefits.

Table 9 illustrates the computation of benefit cost ratios. For ease of comparison, the annual benefits were capitalized to a present worth. Life over which the benefits were capitalized was assumed to be 30 years. Interest of 10% was used.

TABLE 7

ROAD USER COSTS: ONE-WAY VEHICULAR TRIPS

	Route	Length (Mi.)	Travel Time (Min.)	Operating Cost	Time Cost	Cost/Vehicular Trip
Rangely — C-a	3	27.4	34	$ 2.47	$ 1.70	$ 4.17
	8	34.9	49.4	3.14	2.47	5.61
	9	24.8	30	2.23	1.50	3.73
Meeker — C-a	-	51.0	71	4.59	3.55	8.14

TABLE 8

ROAD USER COST ROUTE COMPARISONS

Route	Trips, Meeker to C-a, C-a to Meeker	Trips, Rangely to C-a, C-a to Rangely	Daily Road User Cost	Annual Road User Cost	Annual Road User Benefits
3	160	640	$ 3,971	$ 1,449,415	$ 927,465
8	270	530	5,171	1,887,415	489,465
9	130	670	3,557	1,298,305	1,078,575
Base	800		6,512	2,376,880	0

Annual Road User Cost = [(Daily Meeker Trips x $8.14) + (Daily Rangely Trips x Cost/Trip)] x 365

Annual Road User Benefits = Base Annual Road User Cost — Route Alternative Road User Cost

TABLE 9

BENEFIT COST RATIOS

Alternative Route No.	Annual Benefits	Annual Maint. Cost	Capitalized Benefits	Investment	BCR
3	$ 927,465	$ 31,590	$ 8,445,414	$ 11,333,910	0.75
8	489,465	32,940	4,303,661	10,393,620	0.41
9	1,078,575	29,295	9,891,563	10,210,965	0.97

$$\text{BCR} = \frac{[\text{Base Annual Cost} - \text{Route Annual Cost} - \text{Annual Maintenance Cost}] \times \text{PWF}}{\text{Investment}}$$

Accidents and Fuel Consumption

Both accidents and fuel consumption are functions of system vehicle miles of travel. The three route systems and the estimated traffic volumes on each were compared to a base. The base used here is the same as in Reference 1, namely, all trips assigned to a destination at Meeker.

Fuel consumption is the product of annual vehicle miles of travel on a roadway system for an average vehicle use rate of 15 miles per gallon.

Accident rates are based on 1969 Colorado data for rural roads on the State Federal Aid Secondary System. Data were published in "Fatal and Injury Accident Rates on Federal-Aid and Other Highway Systems/1969," U.S. Department of Transportation, Federal Highway Administration.

Computed data are summarized with comparisons shown on Table 10.

TABLE 10

ACCIDENT & FUEL ESTIMATES

		*	**	***	Savings Over Base		
Route	Vehicle mi./yr.	Fuel Cons. gal./yr.	Fatal acc./yr.	Non-fatal inj. acc./yr.	Fuel	Fatal acc.	Non-fatal Inj. acc.
3	9,379,040	625,270	0.46	7.49	367,530	0.27	4.40
8	11,777,455	785,164	0.58	9.40	207,636	0.15	2.49
9	8,484,790	565,653	0.42	6.77	427,147	0.31	5.12
Base	14,892,000	992,800	0.73	11.89			

* 15 mpg.

** Colo. Statistics (1969) 4.91 Fatal Accidents/100 mil. veh. mi.

*** Colo. Statistics (1969) 79.81 Non-fatal Injury Accidents/100 mil. veh. mi.

Timing

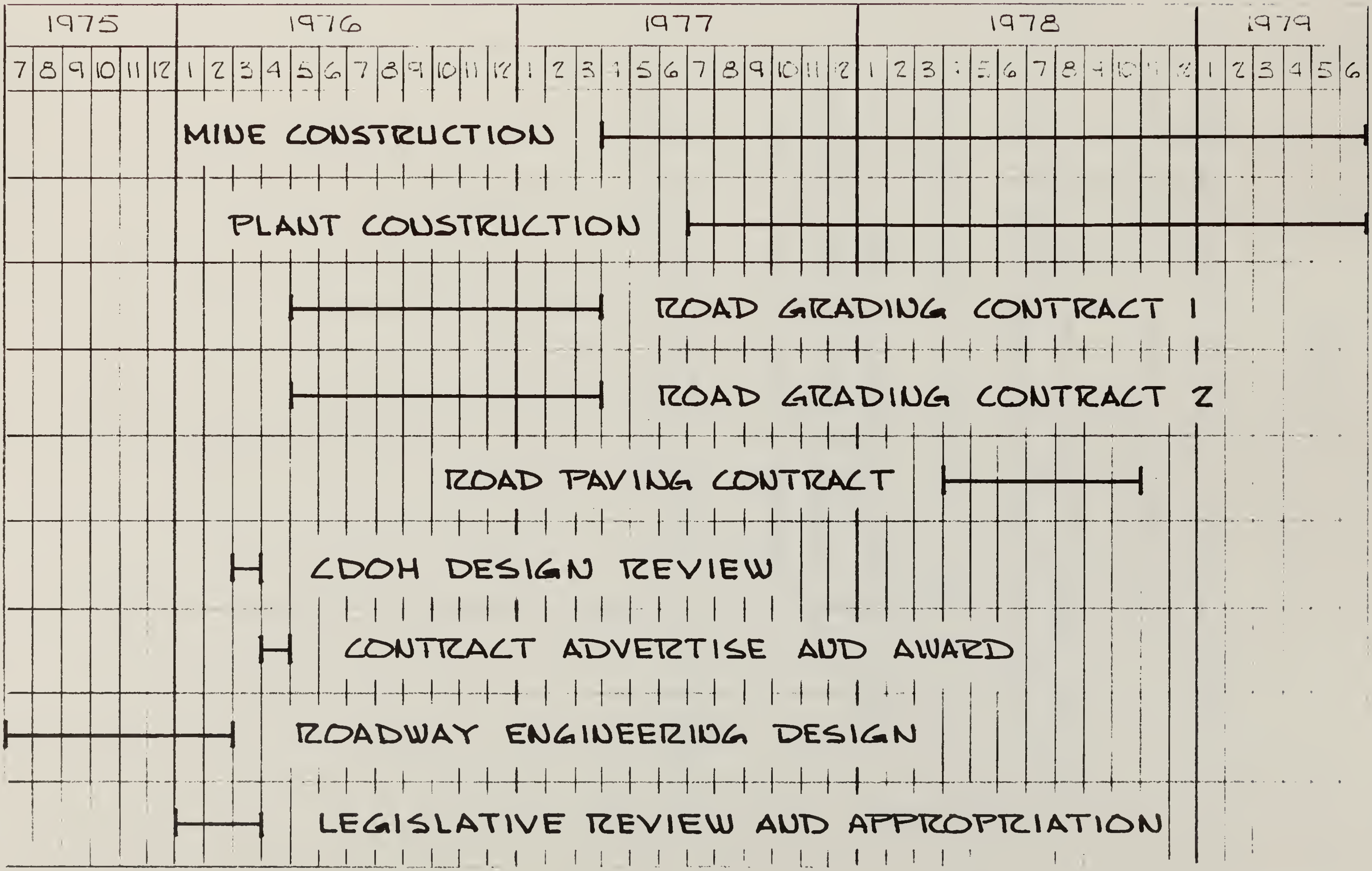
It would be essential, in the development of the area, to establish travel patterns for mine and plant construction employees which would be compatible with long-range planning for housing and travel of the permanent production personnel. To insure this, it would be necessary to have the access road from Rangely to the plant in a condition which would provide reasonable travel conditions for the construction workers.

Given the target date of early 1977 for beginning of site construction and backing off from that date for construction of the Rangely access road, it is apparent that road construction must begin early in construction season 1976. Based on the estimates of quantities prepared for the route selection study, approximately 375 working days would be required for one construction spread to complete grading operations. Assuming a 9-month construction season in the area yields only about 200 working days per construction season, two construction seasons would be required for just the grading operations.

Backing off from the target 1977 start of site construction date shows that the road construction should have begun this past April. It is obvious from these figures that two contracts for grading will be necessary. Thus, the target date could be met if two contracts were awarded to begin construction in April 1976. Pavement surfacing is not included in these contracts. A third contract for surfacing would be required. In conversation with the Department of Highways District Engineer, the desirability was expressed of delaying surfacing until after heavy construction traffic was through and the subgrade proven.

A chart showing the time schedule for critical events isincluded in this report.

TIME SCHEDULE FOR CRITICAL EVENTS



REFERENCES

1. International Engineering Company, Inc. "Preliminary Feasibility Route Selection C-a to Rangely," Rev. March 4, 1975.

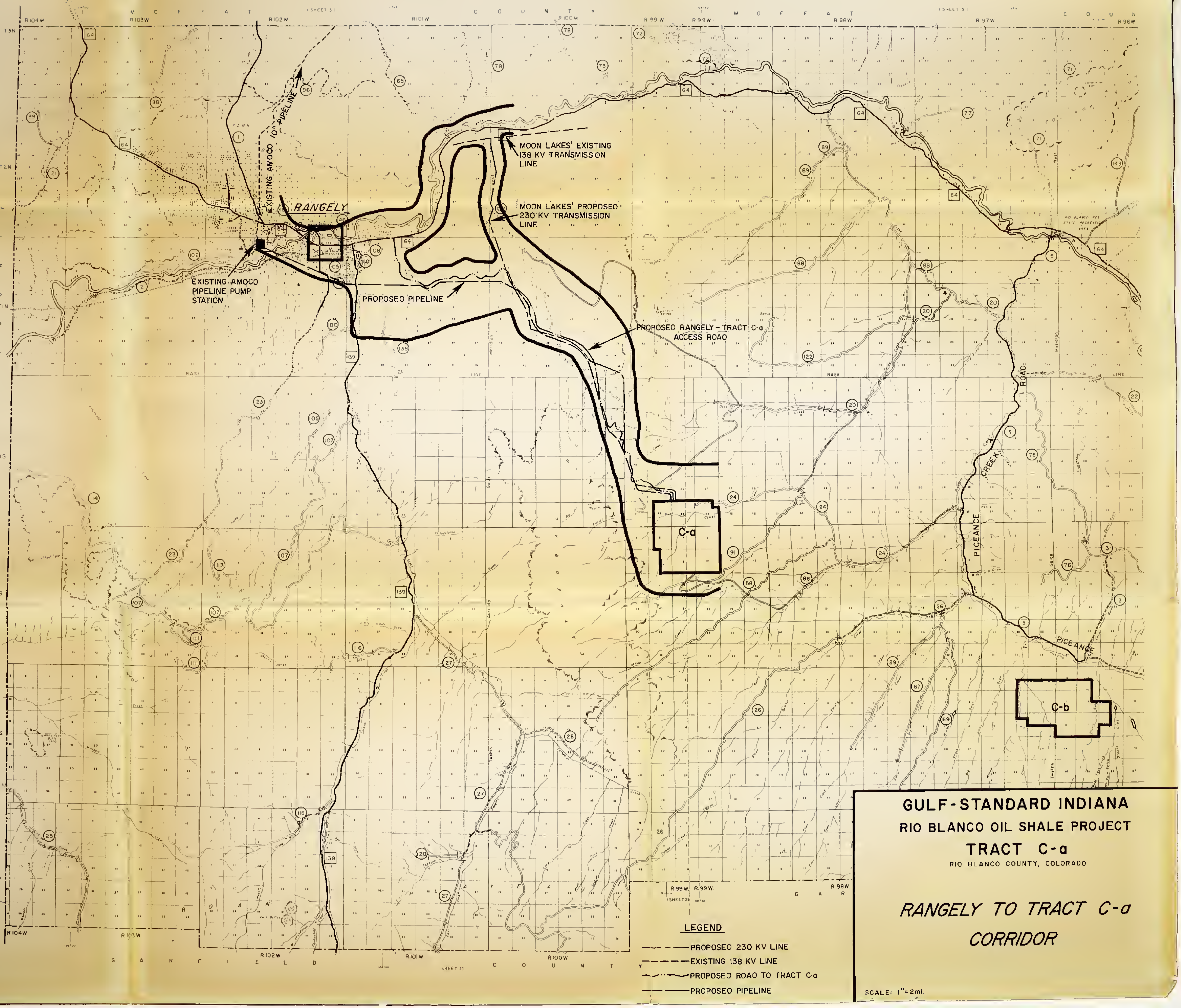
2. U. S. Department of Commerce, Bureau of Public Roads. "Calibrating & Testing a Gravity Model for Any Size Urban Area," October 1965.

3. State of Colorado, Office of the Governor, Oil Shale Planning and Coordination, *Impact, An Assessment of the Impact of Oil Shale Development - Colorado Planning and Management Region 11*. "Volume IV, General Services," December 1974.

4. State of Colorado, State Department of Highways, Division of Highways. "Roadway Design Manual," January 1972.

ROUTE #9 PROPOSED RANGELY — TRACT C-a ACCESS ROAD
RANGELY
R102W
R101W
R100W
T2N
T1N
STATE HWY #64
PRIVATE LANDS
PRIVATE
LANDS
50
100
150
200
250
300
350
400
450
500
600
650
Fletcher Gulch
Gillam Draw
Little Gillam Draw
Cow Gulch
BIG RIDGE
Canyon
Red Hill
WHITE RIVER
COAL OIL RIM
Taylor
Creek
Douglas
BASIN

T1N
PROPOSED MOON LAKE ELECTRIC TRANSMISSION LINE
PRIVATE LANDS
PRIVATE LANDS
STATE DIV. WILDLIFE
PROPOSED PLANT SITE AREA
Future Connection To County Road #24
TEMPORARY COUNTY ROAD #24
PERMANENT COUNTY ROAD #24
T1S
T2S
R98W
R99W
R100W
STATE
WILDLIFE
HUNTING CLUB
TRACT C-a
HORSE
DEAD
SAGEBRUSH
CATHEDRAL BLUFFS
650
700
750
800
850
900
950
1000
1050
1100


MOFFAT COUNTY
RANGELY
EXISTING AMOCO 10" PIPELINE
EXISTING AMOCO PIPELINE PUMP STATION
MOON LAKES' EXISTING 138 KV TRANSMISSION LINE
MOON LAKES' PROPOSED 230 KV TRANSMISSION LINE
PROPOSED PIPELINE
PROPOSED RANGELY - TRACT C-a ACCESS ROAD
C-a
C-b
PICEANCE CREEK ROAD
PICEANCE
CATHEDRAL
GARFIELD COUNTY
UINTAH COUNTY
LEGEND
PROPOSED 230 KV LINE
EXISTING 138 KV LINE
PROPOSED ROAD TO TRACT C-a
PROPOSED PIPELINE
SCALE: 1" = 2 mi.

GULF-STANDARD INDIANA

RIO BLANCO OIL SHALE PROJECT

TRACT C-a

RIO BLANCO COUNTY, COLORADO

RANGELY TO TRACT C-a CORRIDOR

Form 1279–3
(June 1984)

BORROWE

TN 859 .C64 R5636

Proposed Rangely ac
to tract C-a

DATE LOANED	BORROWER

USDI – BLM